

**SUMMARY REPORT OF MISSION ACCELERATION
MEASUREMENTS FOR STS-62**

Launched March 4, 1994

**ORIGINAL CONTAINS
COLOR ILLUSTRATIONS**

Authors:

**Melissa J. B. Rogers
and
Richard DeLombard**

**NASA Lewis Research Center
Cleveland, Ohio**

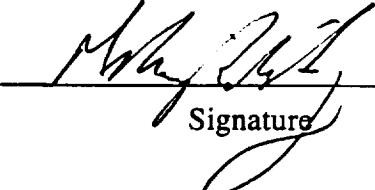


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APPROVAL PAGE

PREPARED BY

Melissa J. B. Rogers
Team Leader, PIMS
Tal-Cut Company
Beachwood, Ohio


Signature

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Date

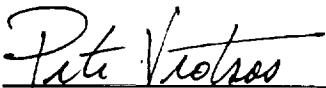
Richard DeLombard
PIMS Project Manager
Microgravity Measurement & Analysis Branch
Space Experiments Division
NASA Lewis Research Center


Signature

10/17/94
Date

APPROVED BY

Pete Vrotsos
Branch Chief
Microgravity Measurement & Analysis Branch
Space Experiments Division
NASA Lewis Research Center


Signature

10/17/94
Date

ABSTRACT

The second mission of the United States Microgravity Payload on-board the STS-62 mission was supported with three accelerometer instruments: the Orbital Acceleration Research Experiment (OARE) and two units of the Space Acceleration Measurement System (SAMS). The March 4, 1994 launch was the fourth successful mission for OARE and the ninth successful mission for SAMS.

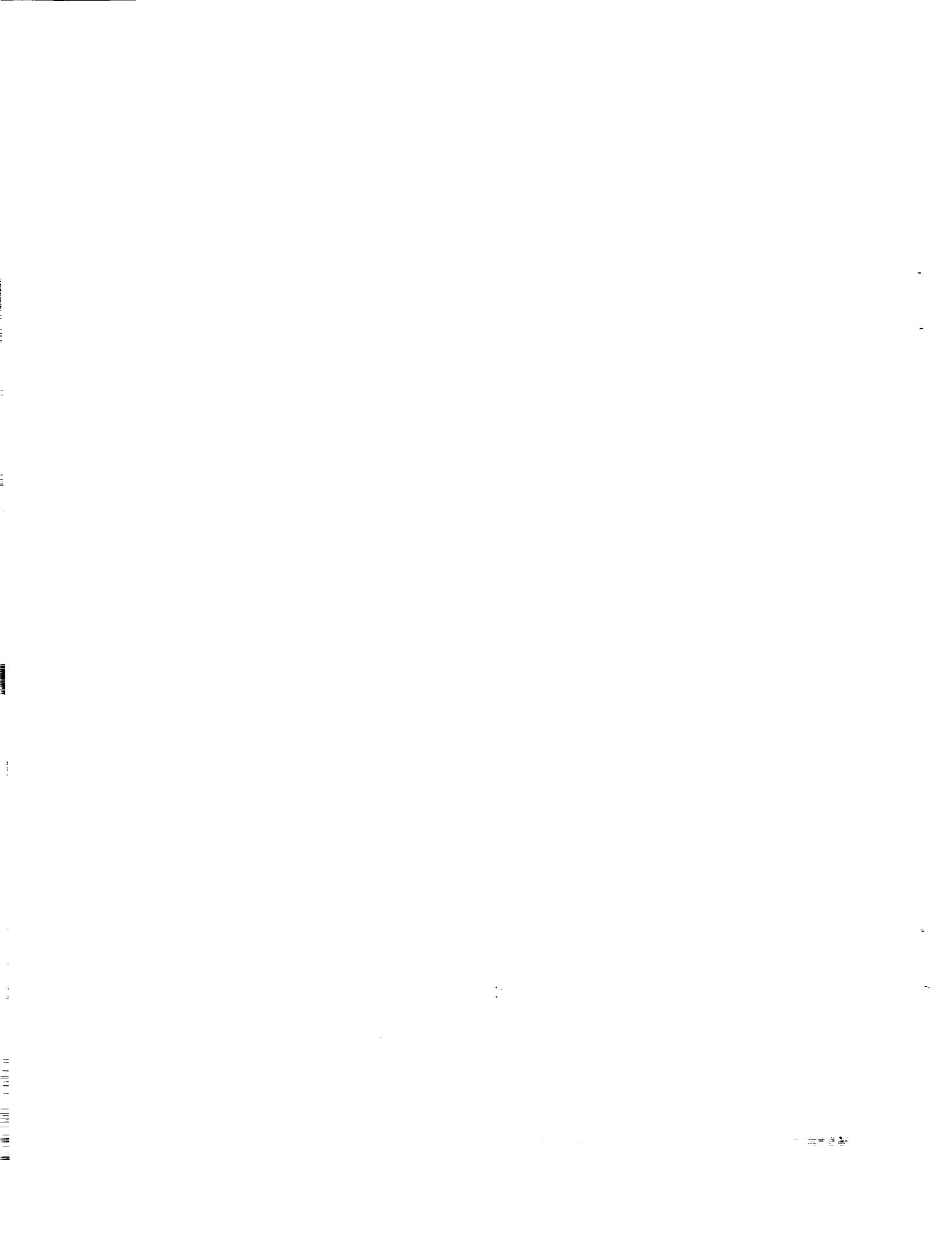
The OARE instrument utilizes a sensor for very low frequency measurements below one Hertz. The accelerations in this frequency range are typically referred to as quasi-steady accelerations.

One of the SAMS units had two remote triaxial sensor heads mounted on the forward MPRESS structure between two furnace experiments, MEPHISTO and AADSF. These triaxial heads had low-pass filter cut-off frequencies at 10 and 25 Hz.

The other SAMS unit utilized three remote triaxial sensor heads. Two of the sensor heads were mounted on the aft MPRESS structure between the two experiments IDGE and ZENO. These triaxial heads had low-pass filter cut-off frequencies at 10 and 25 Hz. The third sensor head was mounted on the thermostat housing inside the IDGE experiment container. This triaxial head had a low-pass filter cut-off frequency at 5 Hz.

This report is prepared to furnish interested experiment investigators with a guide to evaluating the acceleration environment during STS-62 and as a means of identifying areas which require further study. To achieve this purpose, various pieces of information are included, such as an overview of the STS-62 mission, a description of the accelerometer systems flown on STS-62, some specific analysis of the accelerometer data in relation to the various mission activities, and an overview of the low-gravity environment during the entire mission.

An evaluation form is included at the end of the report to solicit users' comments about the usefulness of this series of reports.



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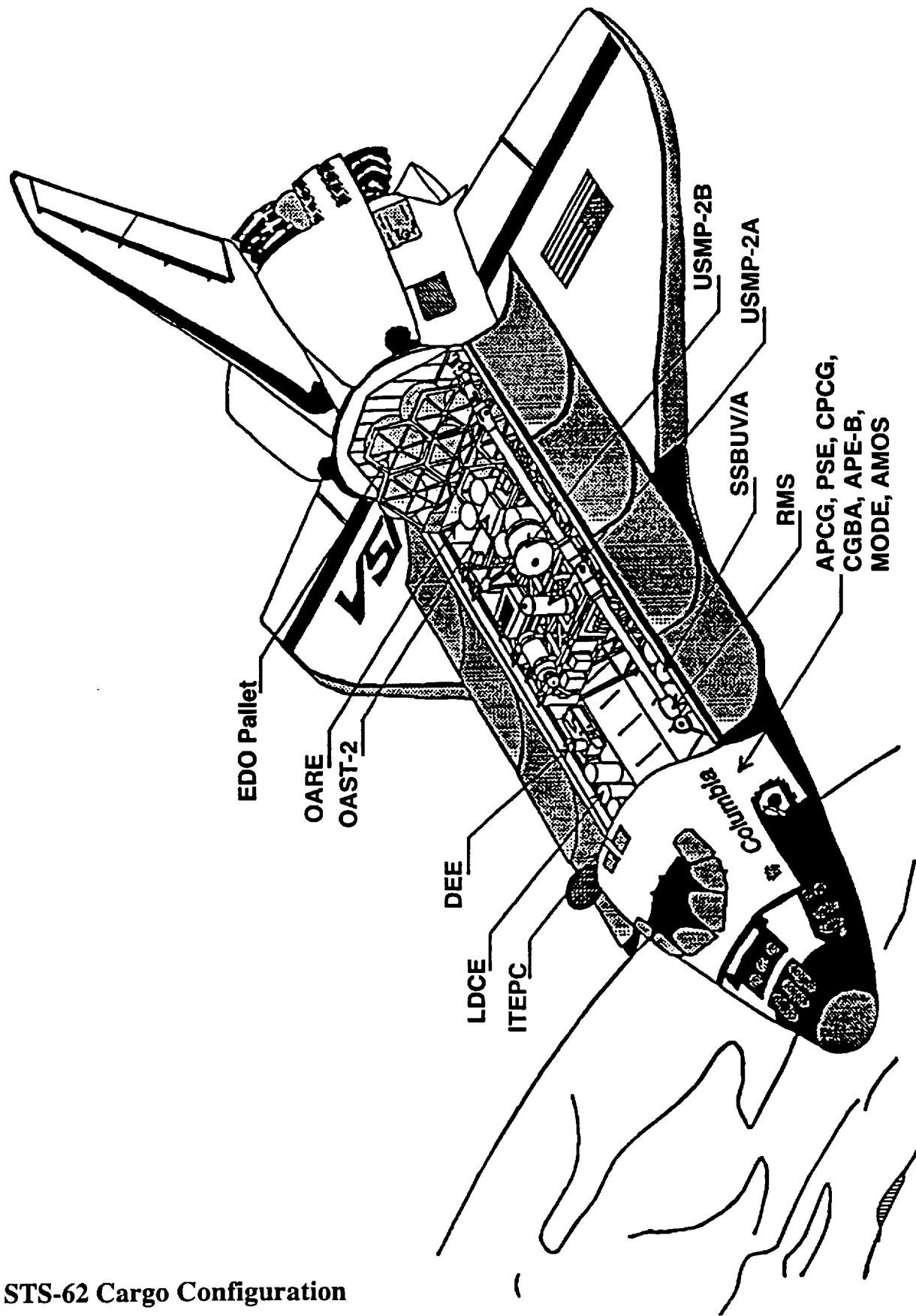
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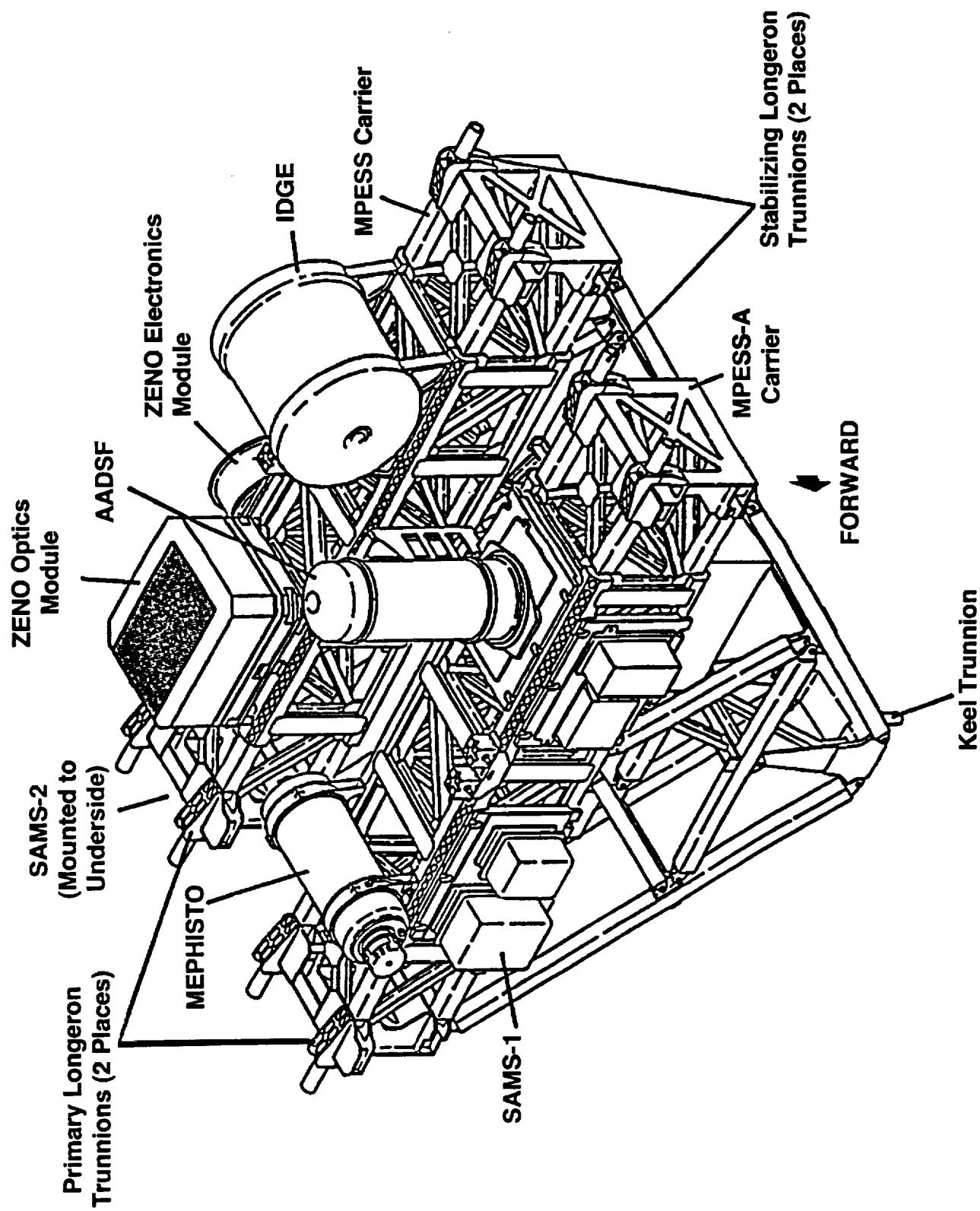
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STS-62 Cargo Configuration



United States Microgravity Payload-2

ACRONYM LIST

| | |
|----------|--|
| AADSF | Advanced Automated Directional Solidification Furnace |
| c.g. | center of gravity |
| DSO | Detailed Supplementary Objective |
| DTO | Development Test Objective |
| EEPROM | electrically erasable programmable read only memory |
| FES | Flash Evaporator System |
| GSFC | NASA Goddard Space Flight Center |
| IDGE | Isothermal Dendritic Growth Experiment |
| JSC | NASA Johnson Space Center |
| KSC | NASA Kennedy Space Center |
| LeRC | NASA Lewis Research Center |
| LV / LH | Local Vertical / Local Horizontal |
| MEPHISTO | Materials for the Study of Interesting Phenomena of Solidification on Earth and in Orbit |
| MET | Mission Elapsed Time(day/hour:minute:second) |
| MPESS | Mission Peculiar Equipment Support Structure |
| MSAD | NASA Headquarters Microgravity Science and Applications Division |
| MSFC | NASA Marshall Space Flight Center |
| OARE | Orbital Acceleration Research Experiment |
| OAST-2 | second Office of Aeronautics and Space Technology payload |
| OMS | Orbital Maneuvering System |
| PCIS | Passive Cycle Isolation System |
| PIMS | Principal Investigator Microgravity Services |
| POCC | MSFC Payload Operations Control Center |
| PSD | power spectral density |
| PRCS | Primary Reaction Control System |
| RCS | Reaction Control System |
| RMS | Orbiter Remote Manipulator System |
| rms | root mean square |
| SAMS | Space Acceleration Measurement System |
| TDRSS | Tracking and Data Relay Satellite System |
| USMP-2 | second United States Microgravity Payload |
| VRCS | Vernier Reaction Control System |
| VV | Velocity Vector |

1. Introduction and Purpose

Fluid physics, materials sciences, and life sciences experiments are conducted on the NASA Space Shuttle Orbiters to take advantage of the reduced gravity environment resulting from the continuous free fall state of low earth orbit. While being in orbit does result in zero-gravity at the center of gravity (c.g.) of the Orbiter, at any point away from the c.g. some residual acceleration exists. These "quasi-steady accelerations" are related to the distance from the Orbiter c.g., the aerodynamic drag experienced by the Orbiter but not by free floating objects or fluids within the Orbiter, and the effects of the rotation and motion of the Orbiter. Accelerometer systems are flown on the Orbiters to record the levels of residual acceleration as well as vibrations of the Orbiter, equipment, and local structures, commonly referred to as g-jitter. The quasi-steady and g-jitter environment of the Orbiter are generally referred to as the microgravity or low-gravity environment.

The second United States Microgravity Payload (USMP-2) flew on the Orbiter Columbia on mission STS-62 in March 1994. The USMP-2 portion of STS-62 was dedicated to microgravity experiments. To support these experiments, two accelerometer systems managed by the NASA Lewis Research Center (LeRC) were flown. The Orbital Acceleration Research Experiment (OARE) and the Space Acceleration Measurement System (SAMS) are sponsored by the Microgravity Science and Applications Division (MSAD) of the NASA Office of Life and Microgravity Science and Applications.

The Principal Investigator Microgravity Services (PIMS) project was created at the NASA Lewis Research Center to support principal investigators of microgravity experiments as they evaluate the effects of varying acceleration levels on their experiments. This report is provided by PIMS to furnish interested experiment investigators with a guide to evaluating the acceleration environment during STS-62 and as a means of identifying areas which require further study. To achieve this purpose, we present various pieces of information. Section 2 of this report provides an overview of the STS-62 mission: the payloads, the experiments manifested on the payloads, and the particular activities which may be of interest to microgravity investigators. Section 3 describes the accelerometer systems flown on STS-62 and the means by which they recorded data and provided data to the user. Section 4 discusses some specific analysis of the accelerometer data in relation to the various activities which occurred during the mission. The appendices outline processing applied to the SAMS and OARE data to provide an overview of the microgravity environment during the entire mission. Plots resulting from this analysis are also provided as a snapshot of the environment. Appendix E contains a user comment sheet. Users are encouraged to complete this form and return it to the authors.

2. Mission Overview

At 8:53 am EST, 4 March 1994, the Space Shuttle Columbia launched on the STS-62 mission from NASA Kennedy Space Center (KSC). Touchdown was on 18 March 1994 at 7:58 am EST at KSC. The primary objectives of the STS-62 mission were to use Columbia as a platform for performing science experiments on USMP-2 and the Office of Aeronautics and Space Technology (OAST)-2 payloads. The USMP-2 experiments focused on studies to create better, faster semiconductors; the behavior of a fluid near its critical point; and the formation of

dendrites during the solidification of a molten material. The USMP-2 experiments are listed in Table 1. The OAST-2 experiments obtained technology data to support future needs for advanced satellites, sensors, microcircuits, and the international space station. Data collected on OAST-2 experiments could lead to cheaper, more reliable, and more operationally efficient spacecraft. The OAST-2 experiments are listed in Table 2. Eleven other payloads were considered secondary objectives on STS-62. These are listed in Table 3. Seventeen development test objectives (DTO) and 20 detailed supplementary objectives (DSO) were accomplished on STS-62; they are listed in Tables 4 and 5.

Numerous activities occurred during the STS-62 mission that are of interest to the microgravity community. While we cannot provide a complete as-flown timeline of all activities that occurred during the mission, we present here a partial listing of those events with the potential to affect the microgravity environment. A partial timeline of these events is given in Table 6. Table 7 is a list of crew exercise times. Investigators of individual experiments should be contacted for detailed experiment timeline information.

Specific activities of interest during STS-62 were crew exercise, experiment latch operations, closed circuit camera motion, radiator latch operations, flash evaporator system and water dump operations, circulation pump activity, Ku-band antenna activity, orbital maneuvering system and primary reaction control system firings, and attitude changes. The microgravity and vibration environment related to these activities is discussed in section 4.

3. Accelerometer Systems

Two accelerometer systems measured the microgravity and vibration environment of the Orbiter Columbia during the STS-62 mission: the Orbital Acceleration Research Experiment and the Space Acceleration Measurement System.

3.1 Orbital Acceleration Research Experiment

The Orbital Acceleration Research Experiment is presently being used by MSAD to provide information on the quasi-steady acceleration levels experienced in the Space Shuttle Orbiters. STS-62 was the first flight of OARE in this function. Previous flights of OARE collected data in support of Orbiter aerodynamics studies [1-4]; OARE data from these earlier flights have been used in microgravity environment interpretation. OARE consists of an electrostatically suspended proof mass sensor, an in-flight calibration station, and a microprocessor which is used for in-flight experiment control, processing, and storage of flight data. OARE is designed to measure and record low-frequency (<1 Hz), low-level acceleration. Data are collected at 10 samples per second and sent to the payload recorder. During STS-62, data from the recorder were downlinked approximately every three hours to the Marshall Space Flight Center POCC where further analysis was performed. The raw data are also filtered using a statistical trimmed-mean filter and stored in OARE EEPROM (electrically erasable programmable ROM). The EEPROM data are recovered post-mission from the OARE unit. For STS-62, OARE data are available from MET 000/00:10 to 013/22:48.

The OARE system is mounted to the floor of Columbia's cargo bay on a keel bridge. The location and orientation of the sensors with respect to the Orbiter structural coordinate system are given in Table 8.

3.2 Space Acceleration Measurement System

The Space Acceleration Measurement System was developed to monitor and measure the low-gravity environment of Orbiters in support of MSAD-sponsored science payloads [5-8]. STS-62 marked the ninth flight of the SAMS system. This was the second flight during which SAMS supplied data to users in near real-time. A SAMS unit typically consists of three remote triaxial sensor heads, connecting cables, and a controlling data acquisition unit with a digital data recording system using optical disks with 200 megabytes of storage capacity per side. On STS-62, two SAMS units flew on the Mission Peculiar Equipment Support Structure (MPESS) carriers in support of USMP-2 experiments. One SAMS unit recorded data using three remote triaxial sensor heads at 50, 50, and 125 samples per second. Lowpass filters were applied to the data with cutoffs at 5, 10, and 25 Hz, respectively. The other SAMS unit recorded data using two remote triaxial sensor heads at 50 and 125 samples per second. Lowpass filters were applied to the data with cutoffs at 10 and 25 Hz, respectively. The locations and orientations of the SAMS heads, with respect to the Orbiter structural coordinate system, are given in Table 9. More detailed descriptions of the SAMS accelerometers are available in the literature [5-9].

On STS-62, SAMS data are available between MET 000/02:30 and 013/16:30. Data from two of the triaxial sensor heads (TSH-1A and TSH-2B) were downlinked in near real-time during the mission. Data from the remaining sensor heads (TSH-1B, TSH-2A, and TSH-2C) were recorded on optical disks. Data from TSH-2A were also routed to the IDGE experiment hardware. There is not a continuous record of SAMS data for the STS-62 mission. The available SAMS on-board data recording time is fixed and the PI's requested that data recording be enabled at times which were crucial for their experiment operations. For downlinked data, there is a nearly continuous record, especially during the USMP-2 prime operations. During the OAST-2 prime operations, there were times when downlink data acquisition was disabled due to the Orbiter operational format for OAST-2 operations. Fig. 1 gives an overview of what SAMS data are available for this mission. Approximately 923 megabytes of SAMS data were downlinked and approximately 1.6 gigabytes of SAMS data were recorded. Appendix A describes how these data can be accessed via the internet.

4. Columbia Microgravity Environment-STS-62

The acceleration environment measured by an accelerometer system on the Orbiter is contributed to by numerous sources. All ongoing operations of crew life support systems and activities and operations of the Orbiter, crew, carrier and experiments tend to have vibratory and/or oscillatory components that contribute to the "background" acceleration environment. In this report we are concerned with the identification of activities that cause acceleration levels above this background. The Appendices provide an overview of the microgravity and vibration environment during the STS-62 mission. Appendix B shows time history plots of SAMS data. Except where noted, all SAMS data plots shown in this document are from SAMS Unit F, Head B (TSH-1B). Appendix C provides a frequency domain representation of the SAMS data. Appendix D shows several plots of OARE data to serve as an overview of the quasi-steady environment during STS-62.

4.1 Crew Sleep

The five member crew of STS-62 worked on a single shift schedule, see Table 6 for approximate times. Figure 2 shows an example of the vibration environment as recorded by SAMS during a crew sleep period. Fig. 2a is the vector magnitude of the three axes of SAMS Unit F, Head B data from MET 006/10:13:00 to 006/10:15:11. The vector magnitude is calculated using the equation $a=\sqrt{x^2+y^2+z^2}$, where (x,y,z) are the three axes of measured acceleration. Fig. 2b shows a power spectral density (PSD) representation of the data. For each axis the PSD is calculated according to Parseval's theorem to give an indication of the frequency distribution of power in the acceleration signal:

$$\text{PSD}(k) = [(X(k))/N]^2$$
$$(1/N)\sum|x(n)|^2 = \sum\text{PSD}(k).$$

The three resulting PSD's are then combined into a vector magnitude representation. The vibration environment is reduced during crew sleep periods compared to periods of crew activity because some equipment is turned off and crew push-off forces are minimal or nonexistent. The remaining SAMS data plots in this section represent the vibration environment during crew, experiment, and Orbiter activities. Fig. 3 shows OARE data for the extent of the STS-62 mission. Crew sleep times appear as periodic relatively quiet regions of the plot, especially evident in the first half of the mission. Other characteristics of this plot will be discussed later in this section.

4.2 Crew Exercise

Fig. 4 shows an example of the vibration environment as recorded by SAMS while a crew member was exercising on the bicycle ergometer. During STS-62, crew exercise was performed with the ergometer mounted to the Passive Cycle Isolation System (PCIS) and hard-mounted to the Orbiter floor. In Fig. 4a note the increased acceleration level at MET 012/00:46:00 indicating an increase in crew exertion level. In Fig. 4b the exercise activity is identified by the excitation of 1.25 and 2.5 Hz frequencies. These frequencies correspond to the pedaling and body motion frequencies of the crew member. Increased excitation of the 4.7 Hz Orbiter structural mode is related to the proximity of this mode to an upper harmonic of the exercise frequency.

4.3 MEPHISTO Operations

In addition to crew related perturbation of the microgravity environment of the Orbiter, experiment, payload, and Orbiter systems can also affect the environment. Fig. 5 shows SAMS Unit F, Head A, data collected during a MEPHISTO latch opening operation. Note the $1.7 \times 10^{-3} g$ magnitude transient lasting about one second at MET 011/10:15. The PSD for these data shows an increased excitation of a 6.8 Hz mode.

4.4 Closed Circuit Camera Operations

An Orbiter closed circuit television system supports the payload deployment and retrieval system. This system makes available five television cameras that can be positioned in the following locations: remote manipulator system (RMS) arm wrist, RMS arm elbow, forward port bulkhead, forward starboard bulkhead, aft port bulkhead, aft starboard bulkhead, and keel. In addition to payload deployment and retrieval observing, these cameras are also used to record exterior camera pictures of the Orbiter cargo bay and/or earth observations. During STS-62 mission support operations in the POCC, PIMS personnel noted a significant amount of down-link video originating from the cargo bay cameras during the crew sleep periods. The camera views were often jerky when the camera was initiating or stopping a pan operation. Upon casual comparison with the downlinked SAMS data, there appeared to be some correlation between the camera motions and disturbances observed in the data. In response to a PIMS request to the JSC Orbiter operations office, the three available cargo bay cameras were panned, tilted, and zoomed in their different modes and directions during a crew sleep period. The time span of the different operations which were conducted are listed in Table 6.

An example of SAMS data during some of these operations is shown in Fig. 6. During this time period (MET 003/09:45 - 09:47), Camera B performed a slow pan for 20 seconds, a fast pan for 10 seconds, a slow tilt for 20 seconds, and a fast tilt for 10 seconds. Note that there appears to be no microgravity disturbance level attributable to the cameras, above the background vibration level of the Orbiter and payloads seen in Fig. 2.

4.5 Radiator Deploy

One aspect of the Orbiter Environmental Control and Life Support System is the control of Orbiter interior temperatures. Orbiter heat rejection is provided on-orbit by radiator panels attached to the forward payload bay doors. On STS-62, the radiators were deployed at MET 000/03:12. SAMS Unit F, Head A, data recorded during that time are shown in Fig. 7. Note the thirty second long increase in acceleration level in Fig. 7a. This is most likely due to the motor-driven, torque-tube-lever system used to deploy the radiators. Within another thirty seconds, the acceleration level returns to background. In the PSD shown in Fig. 7b, note the increased excitation level at 3.2 and 6.2 Hz.

4.6 Flash Evaporator System

Further heat rejection is provided on-orbit by the flash evaporator system (FES). FES operations provide heat rejection by vaporizing excess water as it contacts a core filled with hot Freon-21 and venting the resulting vapor out two opposing nozzles on the aft Orbiter. FES operations and their effect on the microgravity environment of the Orbiters are discussed in the literature [10]. Fig. 8 shows OARE data collected during a transition between FES off and FES on times. This FES dump occurred from 003/03:20 to 003/07:00. Most FES activity during STS-62 occurred while the crew was awake. The change in OARE data indicative of FES activity is discernible above the increased acceleration levels related to crew activity. Note that

at approximately 003/03:15 the mean level of the OARE X_b, Y_b, and Z_b data shift by $\sim 4 \times 10^{-7} g$, $\sim -2 \times 10^{-7} g$, and $\sim -3 \times 10^{-7} g$, respectively. This is the same reaction to FES activity identified on the STS-50 mission [10].

A waste water dump was started at approximately the same time as the FES operations discussed above. The large transients seen most clearly in the Y_b and Z_b axes of Fig. 8 are caused by RCS thrusters which were fired to counteract the torque forces of the Orbiter about the positive yaw (Z_b) axis [10].

4.7 Circulation Pumps

The electric motor-driven pumps of the three independent Orbiter hydraulic subsystems have an impact on the microgravity environment. The hydraulic subsystem provides power to actuate aerodynamic flight control surfaces, main engine gimbal and valve controls, external tank umbilical retractor, main and nose landing gear uplock and deployment, main landing gear brakes, and nose wheel steering. In orbit, three electric motor-driven pumps are used periodically to circulate the hydraulic fluid to maintain the temperature of the subsystem [11]. The timing of circulation pump activity can be influenced by experiment microgravity requirements. Fig. 9 shows SAMS data collected when Circulation Pump 2 was activated during STS-62. Note in Fig. 9a the relatively large magnitude, short duration transient at MET 008/14:19:55 and the two lower magnitude transients that occur about 75 and 85 seconds later. This data signature appears to be characteristic of the initiation of circulation pump activity. The exact cause of this signature is under investigation. The large magnitude transient signal manifests itself in the PSD of Fig. 9b as an increase in energy level across the entire frequency spectrum. Note that this PSD plot has a different scale than previous plots.

4.8 Ku-band Antenna

The Orbiter Ku-band antenna system is used to transmit voice, data, and video images to the ground via the Tracking and Data Relay Satellite System (TDRSS). The deployed Ku-band assembly is located on the Orbiter sill, near the forward starboard bulkhead. The Ku-band antenna dithers at a frequency of 17 Hz to maintain the ability to smoothly search for and track the TDRSS satellites. This dither is generally active when in orbit. When the Ku-band antenna is in certain operational modes, the dither is deactivated. In acceleration data collected on-orbit, the 17 Hz dither frequency is clearly seen when the dither is on. Fig. 10 shows STS-62 SAMS data when the dither was cycled off and on two times in relatively quick succession. The magnitude of the 17 Hz signal is significantly reduced when the dither is turned off (times bracketed in Fig. 10a).

4.9 Thrusters

The Orbiter orbital maneuvering system (OMS) and reaction control system (RCS) are used to provide thrust on-orbit. There are two OMS engines facing aft on either side of the Orbiter's aft fuselage. OMS thrust is used to modify an orbit for payload rendezvous or deploy, or to change orbit. Each OMS engine provides 6,000 pounds of thrust. The minimum firing duration of an OMS engine is two seconds. During single OMS operations, roll RCS activity

also occurs. During OAST-2 operations on STS-62, three OMS burns, designated OMS-3, OMS-4, and OMS-5 occurred. Fig. 11 shows SAMS data collected during the OMS-4 burn. Note the $3 \times 10^{-2} g$ shift of the acceleration mean level during the burn, followed by a return to the original mean upon burn completion. This signature is typical of OMS engine burns.

The forward and aft RCS on the Orbiters provides thrust for attitude maneuvers and small translational velocity changes on-orbit. The three locations of the RCS are the forward fuselage nose area, and the left and right OMS/RCS pods attached to the aft fuselage. The forward RCS has fourteen primary and two vernier RCS engines, PRCS and VRCS, respectively. The aft RCS has 12 PRCS and two VRCS engines in each pod. The PRCS engines provide 870 pounds of thrust each and are used in steady-state thrusting mode for one to 150 seconds, and in pulse mode with a minimum thrust time of 80 milliseconds. The VRCS engines provide 24 pounds of thrust each and are used in steady-state thrusting mode for one to 125 seconds, and in pulse mode with a minimum thrust time of 80 milliseconds. Fig. 12 shows SAMS data collected during DSO-324, a NASA JSC DSO aimed at evaluating the payload on-orbit low-frequency environment. For this DSO, the PRCS engines were fired numerous times over a period of six minutes. Note that the time domain magnitudes are on the order of $10^{-2} g$ and that the PSD representation shows an increase in energy level across the entire frequency spectrum compared to Fig. 2a.

4.10 Orbiter Attitude

During the course of an Orbiter mission, the Orbiter vehicle is controlled to maintain certain parameters, such as pointing, rotation rates, or attitudes. These parameters are customarily defined by the primary payload(s) of a particular mission, the Orbiter program office, the crew office, and the safety office. For a typical microgravity science mission, the attitude is maintained to optimize certain secondary parameters, such as the net quasi-steady acceleration, duration and frequency of thruster firings, and attitude changes during the course of the mission.

The STS-62 mission had several primary attitudes defined for the two primary payloads, USMP-2 and OAST-2. The attitude flown for the USMP-2 payload during the majority of the first seven days of the mission (MET 000/10:00 to 006/19:40) was -ZLV/+YVV, Fig. 13. This attitude was chosen to minimize attitude changes and the amount of thruster firings required during the AADSF operations from MET 000/16:00 to 006/12:00. Two additional attitudes, also shown in Fig. 13, were flown at the end of the USMP-2 time for MEPHISTO operations. The XLV/-ZVV attitude was flown from MET 006/19:40 to 008/00:25 and the -XLV/+ZVV attitude was flown from MET 008/00:25 to 009/16:45. During the OAST-2 operations from MET 009/16:45 through MET Day 012, the attitude of the Orbiter was changed frequently in support of various experiments.

The transitions from the -ZLV/+YVV to the -XLV/-ZVV and then to the -XLV/+ZVV attitude can be seen around MET hours 163 and 192 in the OARE data shown in Fig. 3. Two twenty minute windows which encompass these attitude changes are shown in Fig. 14 and 15. The large excursions in the acceleration levels at the transition times are due to the Orbiter thrusters used to change the attitude. The accelerations introduced from attitude maneuvers of this nature are linear accelerations from the thrusters, the attendant Orbiter/payload structural response, and the centripetal accelerations from any rotation of the Orbiter.

The quasi-steady acceleration vector changes direction as a result of these transitions. For the transitions shown in Figs. 14 and 15, the resultant quasi-steady acceleration vector is in the (-0.213, -0.138, -0.967) direction (Orbiter body axes) before the attitude change and changes to the (0.788, -0.087, 0.610) direction after the first attitude change and to the (0.852, -0.345, -0.395) direction after the second attitude change. This illustrates why some experiments require a certain attitude during their critical operations so that a particular quasi-steady acceleration environment is maintained.

4.11 Modeled Environment

The quasi-steady environment during STS-62 can be compared to the environment predicted by numerical modeling. Fig. 16 shows the predicted quasi-steady environment at the OARE location for a three hour period [13]. Acceleration components considered by the model are aerodynamic drag, gravity gradient, and rotational effects. Other low-frequency accelerations such as those induced by FES operations are not modeled. Fig. 17 shows the environment measured by OARE for a comparable time period, that is, same location in orbit and same level of crew activity. Note that the predicted and measured environment are consistent. The difference in sign between the two plots is due to a difference in reference frame, see [10].

Figures 18-20 show the measured acceleration environment for three additional locations: the Orbiter c.g., the Advanced Automated Directional Solidification Furnace (AADSF), and the Isothermal Dendritic Growth Experiment (IDGE). Acceleration data at the c.g. are computed by calculating the gravity gradient and rotational velocity components at the OARE location and removing them from the OARE data [3-4]. An inverse process is performed using c.g. acceleration data to compute the acceleration environment for AADSF and IDGE. The calculations require information about the location of the Orbiter c.g., the orbiter attitude, and the Orbiter body axis rotation rates. Analysis shows that the variation of the c.g. location is negligible in the calculation of gravity gradient and rotational velocity contributions. Pitch rate, yaw rate, and rotational acceleration components were neglected in the computations.

5. Summary

This report serves as a road map to the SAMS and OARE data acquired during the STS-62 mission. Further analysis of specific events and comparisons with other missions will be performed and published in future documents.

There were two primary payloads for the STS-62 mission: the USMP-2 and the OAST-2. Two SAMS units were onboard STS-62 to support the USMP-2 experiments. Five SAMS triaxial sensor heads were mounted at various locations on the MPESS carrier among the four science experiments. The OARE instrument was mounted in the Orbiter cargo bay to support the USMP-2 experiments.

A summary of the vector magnitude rms and average accelerations for the entire mission was produced for a SAMS 25 Hz triaxial sensor head. Spectrograms were also produced to give a frequency domain summary for the entire mission. These plots are presented in the Appendices along with plots of OARE data representing the quasi-steady environment during the

mission. Significant events were chosen to give a more detailed look at the acceleration disturbances at the SAMS and OARE sensor head locations. These events were crew exercise, MEPHISTO latch operations, closed circuit camera motion, radiator latch operations, FES and water dump operations, circulation pump activity, Ku-band antenna activity, orbital maneuvering system and primary reaction control system firings, and attitude changes.

6. References

- [1] Blanchard, R. C., M. K. Hendrix, J. C. Fox, D. J. Thomas, and J. Y. Nicholson, Orbital Acceleration Research Experiment. *J. Spacecraft and Rockets*, Vol. 24, No. 6, (1987) 504-511.
- [2] Blanchard, R. C., J. Y. Nicholson, and J. R. Ritter, STS-40 Orbital Acceleration Research Experiment Flight Results During a Typical Sleep Period. NASA Technical Memorandum 104209, January 1992.
- [3] Blanchard, R. C., J. Y. Nicholson, J. R. Ritter, Preliminary OARE Absolute Acceleration Measurements on STS-50 NASA Technical Memorandum 107724, February 1993.
- [4] Blanchard, R. C., J. Y. Nicholson, J. R. Ritter, and K. T. Larman, OARE Flight Maneuvers and Calibration Measurements on STS-58, NASA Technical Memorandum 109093, April 1994.
- [5] DeLombard, R., B. D. Finley, Space Acceleration Measurement System description and operations on the First Spacelab Life Sciences Mission. NASA Technical Memorandum 105301, November 1991.
- [6] DeLombard, R., B. D. Finley, and C. R. Baugher, Development of and flight results from the Space Acceleration Measurement System (SAMS). NASA Technical Memorandum 105652, January 1992.
- [7] Baugher, C. R., G. L. Martin, and R. DeLombard, Low-frequency vibration environment for five shuttle missions. NASA Technical Memorandum 106059, March 1993.
- [8] Rogers, M. J. B., C. R. Baugher, R. C. Blanchard, R. DeLombard, W. W. Durgin, D. H. Matthiesen, W. Neupert, and P. Roussel, A comparison of low-gravity measurements onboard Columbia during STS-40. *Microgravity Science and Technology VI/3* (1993) 207-216.
- [9] Finley, B. D., C. Grodsinsky, and R. DeLombard, Summary report of mission acceleration measurements for SPACEHAB-01, STS-57. NASA Technical Memorandum 106514, March 1994.

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- [10] Rogers, M. J. B., B. P. Matisak, and J. I. D. Alexander, Venting force contributions: quasi-steady acceleration on STS-50. *Microgravity Science and Technology* (in print).
- [11] Shuttle Operational Data Book, Volume 1, JSC-08934, Rev. E, Johnson Space Center, Houston, TX, January 1988.
- [12] Crew exercise timeline provided by Rick Connell, Krug Life Sciences, Houston, TX.
- [13] Data plot provided by Brian Matisak, Teledyne - Brown Engineering, Huntsville, AL.

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Table 1. USMP-2 Experiments

| Experiment Name | Principal Investigator | Affiliation |
|---|---------------------------------------|--|
| Advanced Automated Directional Solidification Furnace (AADSF) | Dr. S. Lehoczky | Space Science Laboratory, NASA MSFC |
| Materials for the Study of Interesting Phenomena of Solidification on Earth and in Orbit (MEPHISTO) | Dr. R. Abbaschian Dr. J. J. Favier | University of Florida Center for Nuclear Studies, Grenoble |
| Isothermal Dendritic Growth Experiment (IDGE) | Dr. M. Glicksman | Rensselaer Polytechnic Institute |
| Critical Fluid Light Scattering Experiment (Zeno) | Dr. R. Gammon | University of Maryland |
| Space Acceleration Measurement System (SAMS) | R. Sicker (Project Manager) | NASA LeRC |

Table 2. OAST-2 Experiments

| Experiment Name | Principal Investigator | Affiliation |
|--|--|---|
| Solar Array Module Plasma Interaction Experiment (SAMPIE) | Lawrence Wald (Experiment Manager) | NASA LeRC |
| Cryogenic Two-Phase (CRYOTP) | Marco Stoyanof Mel Bello Matt Buchko | USAF Phillips Laboratory Aerospace Corp. NASA GSFC |
| Emulsion Chamber Technology (ECT) | J. Gregory | NASA MSFC |
| Thermal Energy Storage (TES) | Andrew Szaniszlo (Project Manager) | NASA LeRC |
| Experimental Investigation of Spacecraft Glow / Spacecraft Kinetic Infrared Test (SKIRT) | | NASA JSC, Lockheed Palo Alto Research Laboratory, USAF Phillips Laboratory |

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Table 3. STS-62 Secondary Objectives

| Experiment Name | Principal Investigator | Affiliation |
|--|--|---|
| Dexterous End Effector (DEE) | NASA Office of Space Systems Development (Sponsor) | NASA JSC Automation and Robotic Division (Management) |
| Shuttle Solar Backscatter Ultraviolet (SSBUV) A | Ernest Hilsenrath | NASA GSFC |
| Limited Duration Space Environment Candidate Exposure (LDCE) | John F. Wallace Dawn Davis | Case Western Reserve University |
| Air Force Maui Optical Site (AMOS) | | Air Force Geophysical Laboratory |
| Advanced Protein Crystal Growth (APCG) | Dan Carter Lawrence DeLucas | NASA MSFC University of Alabama in Birmingham |
| Auroral Photography Experiment (APE) B | US Air Force (Sponsor) | |
| Commercial Generic Bioprocessing Apparatus (CGBA) | Marvin Luttges (Program Manager) | Bioserve Space Technologies, University of Colorado |
| Commercial Protein Crystal Growth (CPCG) | Charles E. Bugg Marianna Long Lawrence DeLucas | University of Alabama in Birmingham |
| Middeck Zero-Gravity Dynamics Experiment (MODE) | Edward F. Crawley | Massachusetts Institute of Technology |
| Physiological Systems Experiment (PSE) | W. C. Hymer | Pennsylvania State University |
| Bioreactor Demonstration System (BDS) A | | NASA JSC |

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Table 4. STS-62 Development Test Objectives

| DTOs | Description |
|----------|--|
| DTO 254 | Subsonic aerodynamic verification |
| DTO 301D | Ascent structural capability evaluation |
| DTO 307D | Entry structural capability evaluation |
| DTO 312 | ET TPS performance (methods 1, 2, and 3) |
| DTO 319D | Shuttle/payload low-frequency environment |
| DTO 413 | On-orbit PRSD cryogenic hydrogen boil-off |
| DTO 414 | APU shutdown test, sequence A (shut down 3, then 1, then 2) |
| DTO 521 | Orbiter drag chute system |
| DTO 656 | PGSC single-event upset monitoring |
| DTO 664 | Cabin temperature survey |
| DTO 667 | Portable in-flight landing operations trainer |
| DTO 670 | Evaluation of passive cycle isolation system |
| DTO 674 | Thermoelectric liquid cooling system evaluation |
| DTO 678 | Infrared thermal survey of Orbiter crew compartment, Spacelab, and SPACEHAB module |
| DTO 679 | Ku-band communications adapter demonstration |
| DTO 805 | Crosswind landing performance |
| DTO 910 | OEX Orbital Acceleration Research Experiment (OARE) |

Table 5. STS-62 Detailed Supplementary Objectives

| DSOs | Description |
|----------|--|
| | |
| DSO 324 | Payload on-orbit low-frequency environment |
| DSO 326 | Window impact observations |
| DSO 485 | Inter-Mars tissue equivalent proportional counter (ITEPC) |
| DSO 487 | Immunological assessment of crew members |
| DSO 492 | In-flight evaluation of a portable clinical blood analyzer |
| DSO 603B | Orthostatic function during entry, landing, and egress |
| DSO 604 | Visual-vestibular integration as a function of adaptation |
| DSO 605 | Postural equilibrium control during landing/egress |

SUMMARY REPORT OF MISSION ACCELERATION MEASUREMENTS FOR STS-62

Table 6. STS-62 Event Timeline (Partial)

| MET | EVENT |
|---------------------|---|
| | |
| 000/02:33:30 | KU BAND ANTENNA DEPLOY COMPLETE |
| 000/03:12 | RADIATOR DEPLOY |
| 000/04:05 (APPROX) | START SAMS/OARE MANEUVER-KU NOT INHIBITED |
| 000/05:03:35 | RMS/DEE OPS HAVE STARTED |
| 000/10:30-006/19:20 | FES ENABLED |
| 000/11 | SLEEP |
| 006/19:20-007/17:06 | FES OFF |
| 000/19: | POST SLEEP |
| 000/21:20 | FES DUMP START |
| 001/10 | SLEEP |
| 001/18 | POST SLEEP |
| 001/23:40 | MODE OPERATIONS IN MIDDECK |
| 002/09 | SLEEP |
| 002/12:58:00 | INCO MOVING KU FROM TDRS W TO TDRS E |
| 002/17 | POST SLEEP |
| 002/17:47 | FUEL CELL PURGE IN 15 MINUTES |
| 002/22:54:33 | START FES NOW |
| 003/08 | SLEEP |
| 003/09:40-003/11:34 | PIMS REQUESTED CAMERA OPERATIONS |
| 003/03:10 (APP)- | WASTE WATER DUMP |
| 003/03:50:57 | |
| 003/16 | POST SLEEP |
| 004/07 | SLEEP |
| 004/15 | POST SLEEP |
| 005/06:40 | SLEEP |
| 005/14:40 | POST SLEEP |
| 006/06:20 | SLEEP |
| 006/14:20 | POST SLEEP |
| 006/17:40-006/17:48 | FUEL CELL PURGE |
| 006/19:27 | CIRCULATION PUMP ACTIVITY |

SUMMARY REPORT OF MISSION ACCELERATION MEASUREMENTS FOR STS-62

Table 6. STS-62 Event Timeline (Partial), continued

| | |
|-------------------------------|--|
| 007/06 | SLEEP |
| 007/09:57:05 | INTO 1° DEADBAND MOMENTARILY |
| 007/14 | POST SLEEP |
| 008/01:03-008/01:47 | RMS OPERATIONS |
| 008/06 | SLEEP |
| 008/14 | POST SLEEP |
| 008/16:00:50 (05?) | START 2° DEADBAND |
| 008/19:08 | START 1° DEADBAND FOR 1.5 HOURS (-XLV ATTITUDE) |
| 008/20:38 | START 0.3° DEADBAND |
| 008:22:30 | CIRCULATION PUMP ON IN 30 SEC |
| 009/03:19:14 | START 3° DEADBAND |
| 009/03:25 | START 2° DEADBAND |
| 009/06 | SLEEP |
| 009/14 | POST SLEEP |
| 009/17:10 | OMS BURN |
| 009/17:50 | OMS BURN |
| 010:03:58:40- 010:05:39:00 | FES DUMP |
| 010/06 | SLEEP |
| 010/14 | POST SLEEP |
| 011/04:15:00 | SUPPLY WATER DUMP |
| 011/06 | SLEEP |
| 011/14 | POST SLEEP |
| 012/06 | SLEEP |
| 012/14 | POST SLEEP |
| 013/00:30 | RADIATOR STOW AT ABOUT THIS TIME |
| 013/06 | SLEEP |
| 013/14 | POST SLEEP |
| 013/22:13 | OBTAI DE-ORBIT BURN ATTITUDE |

SUMMARY REPORT OF MISSION ACCELERATION MEASUREMENTS FOR STS-62

Table 7. Crew exercise log [12]

| Crewmember | Start MET | Stop MET | Mounting System | Notes |
|------------|-----------|----------|-----------------|--------------------|
| CDR | 0/23:41 | 1/00:06 | PCIS | |
| PLT | 2/03:30 | 2/04:00 | PCIS | Approximate times |
| MS2 | 2/04:20 | 2/05:14 | PCIS | Approximate times |
| MS3 | 2/05:16 | 2/05:50 | PCIS | |
| CDR | 3/02:59 | 3/03:40 | PCIS | |
| MS1 | 3/04:13 | 3/04:42 | PCIS | |
| MS3 | 3/04:49 | 3/05:08 | PCIS | |
| PLT | 4/01:11 | 4/01:49 | PCIS | |
| MS2 | 4/01:50 | 4/02:35 | PCIS | |
| CDR | 4/02:38 | 4/03:30 | PCIS | |
| CDR | 5/00:21 | 5/01:07 | PCIS | |
| MS2 | 5/01:07 | 5/01:43 | PCIS | |
| MS3 | 5/01:45 | 5/02:22 | PCIS | |
| PLT | 5/02:27 | 5/03:01 | PCIS | |
| MS1 | 5/03:05 | 5/03:29 | PCIS | |
| CDR | 6/00:22 | 6/01:03 | PCIS | |
| MS1 | 6/01:24 | 6/01:58 | PCIS | |
| MS2 | 6/07:00 | 6/07:40 | PCIS | |
| PLT | 7/00:45 | 7/01:30 | PCIS | |
| MS3 | 7/01:30 | 7/02:05 | PCIS | |
| MS1 | 8/00:10 | 8/00:43 | PCIS | |
| CDR | 8/00:47 | 8/01:23 | PCIS | |
| MS2 | 8/01:?? | 8/02:01 | PCIS | Missing Start Time |
| PLT | 8/02:01 | 8/02:28 | PCIS | |
| MS3 | 8/02:31 | 8/02:57 | PCIS | |
| CDR | 8/23:59 | 9/0:40 | PCIS | |
| MS2 | 9/??:?? | 9/01:30 | PCIS | Missing Start Time |
| PLT | 9/??:?? | 9/02:33 | PCIS | Missing Start Time |
| MS2 | 9/14:45 | 9/15:19 | PCIS | |
| MS1 | 9/18:01 | 9/18:36 | PCIS | |
| PLT | 9/18:55 | 9/20:27 | PCIS | |
| MS3 | 9/22:00 | 9/22:40 | PCIS | |
| CDR | 10/01:32 | 10/02:16 | PCIS | |
| CDR | 11/00:40 | 11/00:56 | PCIS | |
| MS2 | 11/02:15 | 11/02:50 | PCIS | |
| MS1 | 11/14:31 | 11/14:48 | Hard-Mounted | |
| MS2 | 11/14:48 | 11/15:38 | Hard-Mounted | |
| PLT | 11/20:13 | ? | Hard-Mounted | Missing Stop Time |
| CDR | 12/00:08 | 12/00:50 | Hard-Mounted | |
| PLT | 12/14:45 | 12/15:06 | Hard-Mounted | |
| CDR | 12/15:41 | 12/16:24 | Hard-Mounted | |

SUMMARY REPORT OF MISSION ACCELERATION MEASUREMENTS FOR STS-62

Table 8. STS-62 OARE Head Location and Orientation

| | | |
|--------------------------------|--------------------|---|
| OARE Sensor | | Sample Rate: 10 samples/second |
| Frequency: 0 to 1 Hz | | Location: Orbiter Cargo Bay Keel Bridge |
| ORIENTATION | | LOCATION |
| Orbiter Structural Axis | Sensor Axis | Structural Axis |
| X ₀ | -X _{OARE} | X ₀ = 1153.3 in |
| Y ₀ | Z _{OARE} | Y ₀ = -1.3 in |
| Z ₀ | Y _{OARE} | Z ₀ = 317.8 in |

Table 9. STS-62 SAMS Head Location and Orientation

| | | |
|--------------------------------|--------------------|--------------------------------|
| Unit F Head A (TSH-1A) | | |
| Serial no.: 821-19 | | Sample Rate: 50 samples/second |
| Frequency: 0 to 10 Hz | | Location: MPESS-A Starboard |
| ORIENTATION | | LOCATION |
| Orbiter Structural Axis | Sensor Axis | Structural Axis |
| X ₀ | -Y _h | X ₀ = 925.9 in |
| Y ₀ | Z _h | Y ₀ = 3.81 in |
| Z ₀ | -X _h | Z ₀ = 417.8 in |

| | | |
|--------------------------------|--------------------|---------------------------------|
| Unit F Head B (TSH-1B) | | |
| Serial no.: 821-21 | | Sample Rate: 125 samples/second |
| Frequency: 0 to 25 Hz | | Location: MPESS-A Port |
| ORIENTATION | | LOCATION |
| Orbiter Structural Axis | Sensor Axis | Structural Axis |
| X ₀ | -Y _h | X ₀ = 925.9 in |
| Y ₀ | Z _h | Y ₀ = -5.24 in |
| Z ₀ | -X _h | Z ₀ = 417.8 in |

SUMMARY REPORT OF MISSION ACCELERATION MEASUREMENTS FOR STS-62

Table 9. STS-62 SAMS Head Location and Orientation, continue

| Unit G Head A (TSH-2A) | | |
|-------------------------------|-------------|-----------------------------------|
| Serial no.: 821-4 | | Sample Rate: 50 samples/second |
| Frequency: 0 to 5 Hz | | Location: IDGE Thermostat Housing |
| | | |
| ORIENTATION | | LOCATION |
| Orbiter Structural Axis | Sensor Axis | Structural Axis |
| X_0 | $-X_h$ | $X_0 = 1021.7$ in |
| Y_0 | Y_h | $Y_0 = -42.9$ in |
| Z_0 | $-Z_h$ | $Z_0 = 433.6$ in |
| | | |
| Unit G Head B (TSH-2B) | | |
| Serial no.: 821-34 | | Sample Rate: 50 samples/second |
| Frequency: 0 to 10 Hz | | Location: MPESS Starboard |
| | | |
| ORIENTATION | | LOCATION |
| Orbiter Structural Axis | Sensor Axis | Structural Axis |
| X_0 | Y_h | $X_0 = 1027.3$ in |
| Y_0 | $-Z_h$ | $Y_0 = -3.81$ in |
| Z_0 | $-X_h$ | $Z_0 = 417.8$ in |
| | | |
| Unit G Head C (TSH-2C) | | |
| Serial no.: 821-20 | | Sample Rate: 125 samples/second |
| Frequency: 0 to 25 Hz | | Location: MPESS Port |
| | | |
| ORIENTATION | | LOCATION |
| Orbiter Structural Axis | Sensor Axis | Structural Axis |
| X_0 | Y_h | $X_0 = 1027.3$ in |
| Y_0 | $-Z_h$ | $Y_0 = 5.24$ in |
| Z_0 | $-X_h$ | $Z_0 = 417.8$ in |

SUMMARY REPORT OF MISSION ACCELERATION MEASUREMENTS FOR STS-62

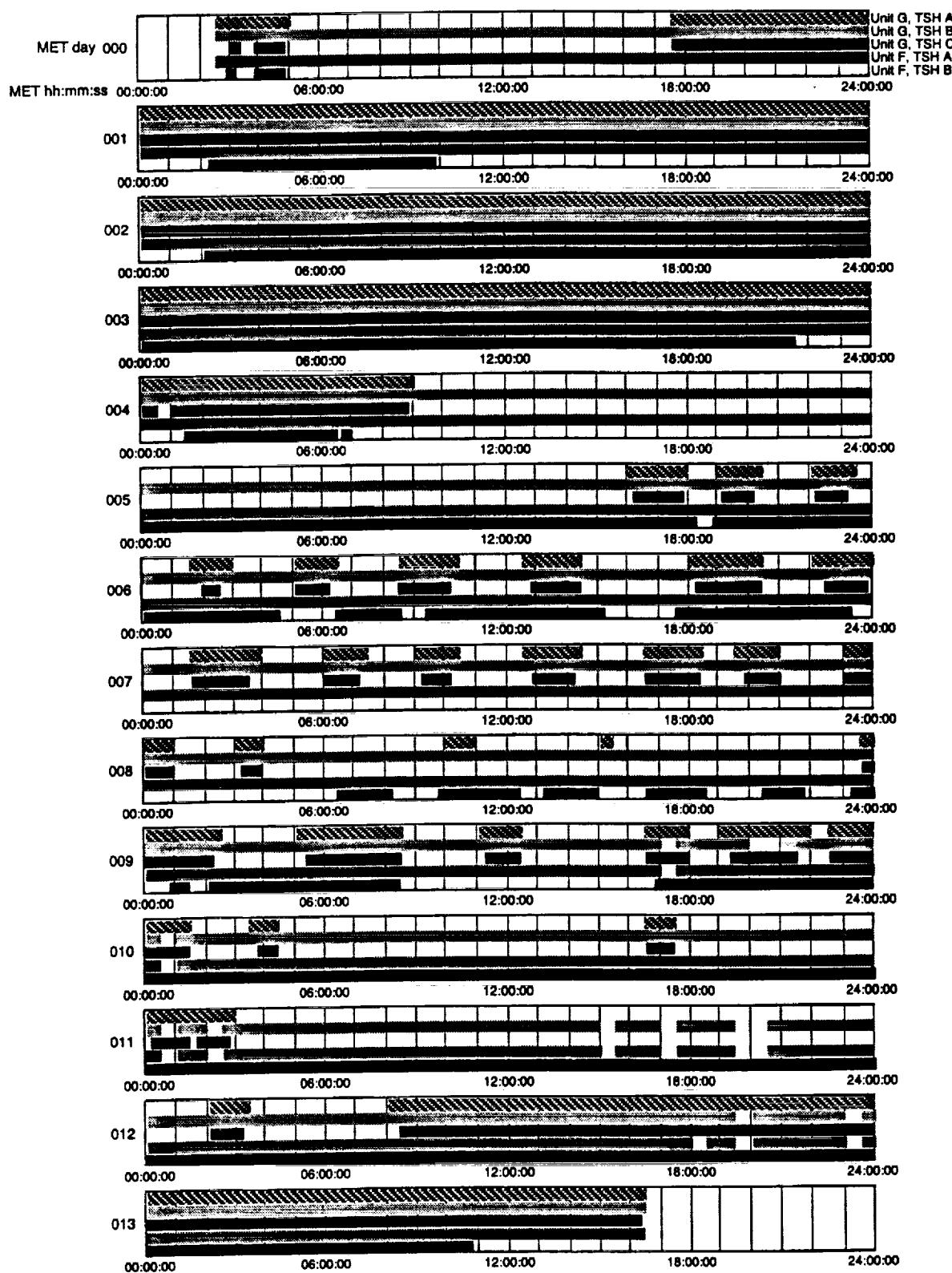


Figure 1 SAMS data availability from STS-62

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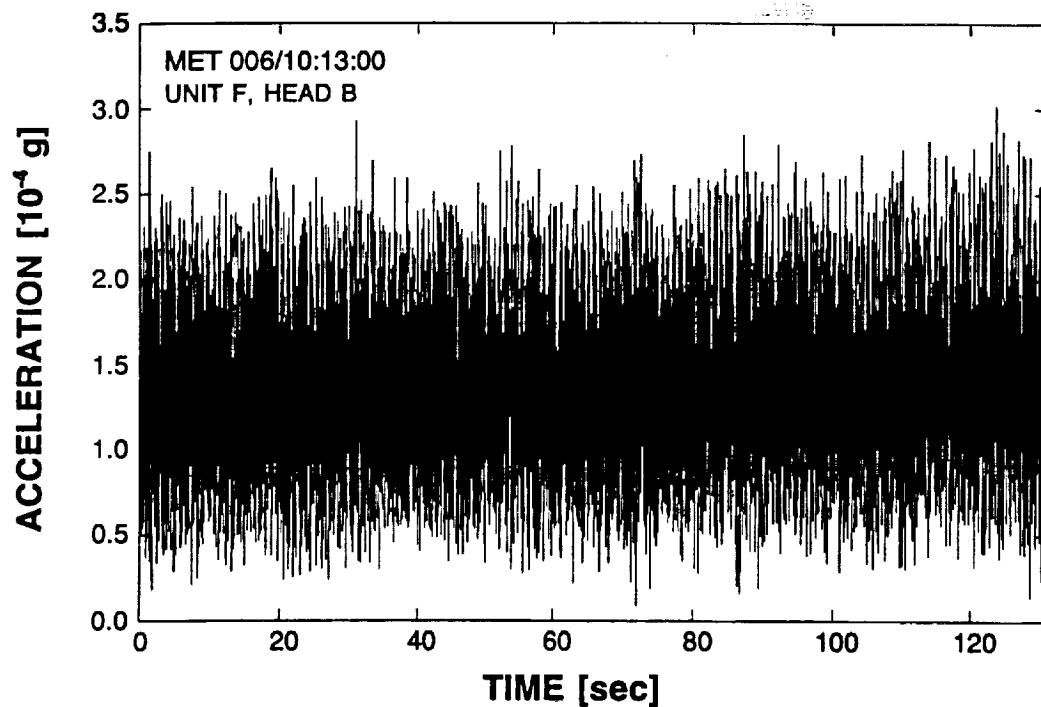


Figure 2a Time Domain vector magnitude of SAMS data for Unit F, Head B,
MET 006/10:13:00 - 006/10:15:10

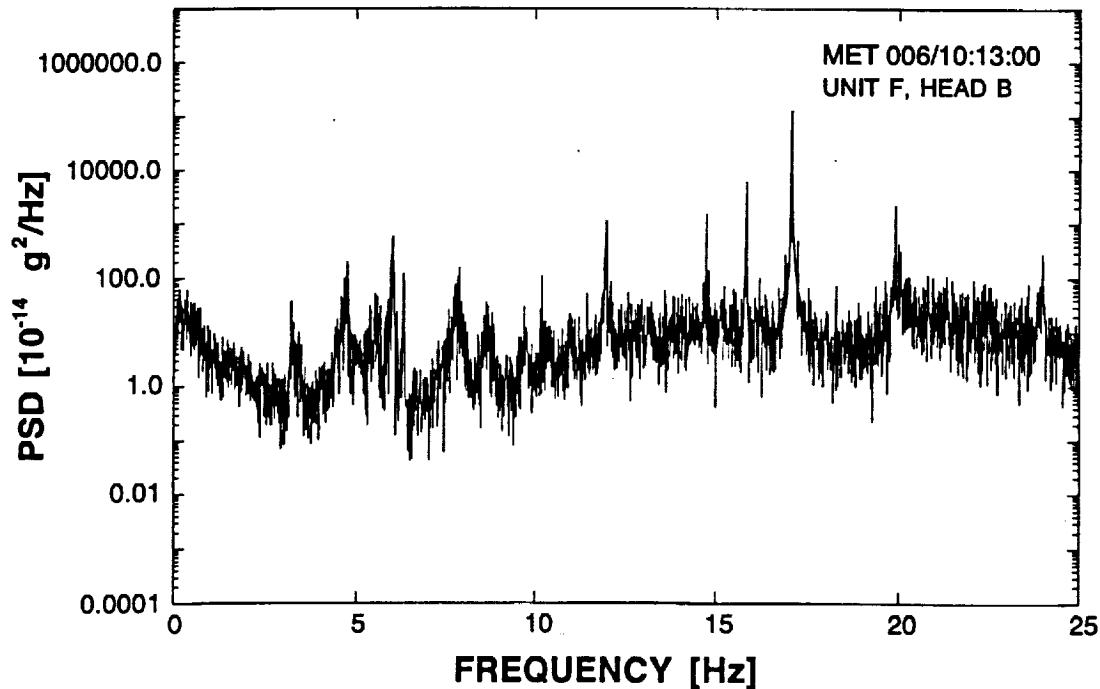


Figure 2b Power spectral density vector magnitude of SAMS data for Unit F, Head B,
MET 006/10:13:00 - 006/10:15:10

SUMMARY REPORT OF MISSION ACCELERATION MEASUREMENTS FOR STS-62

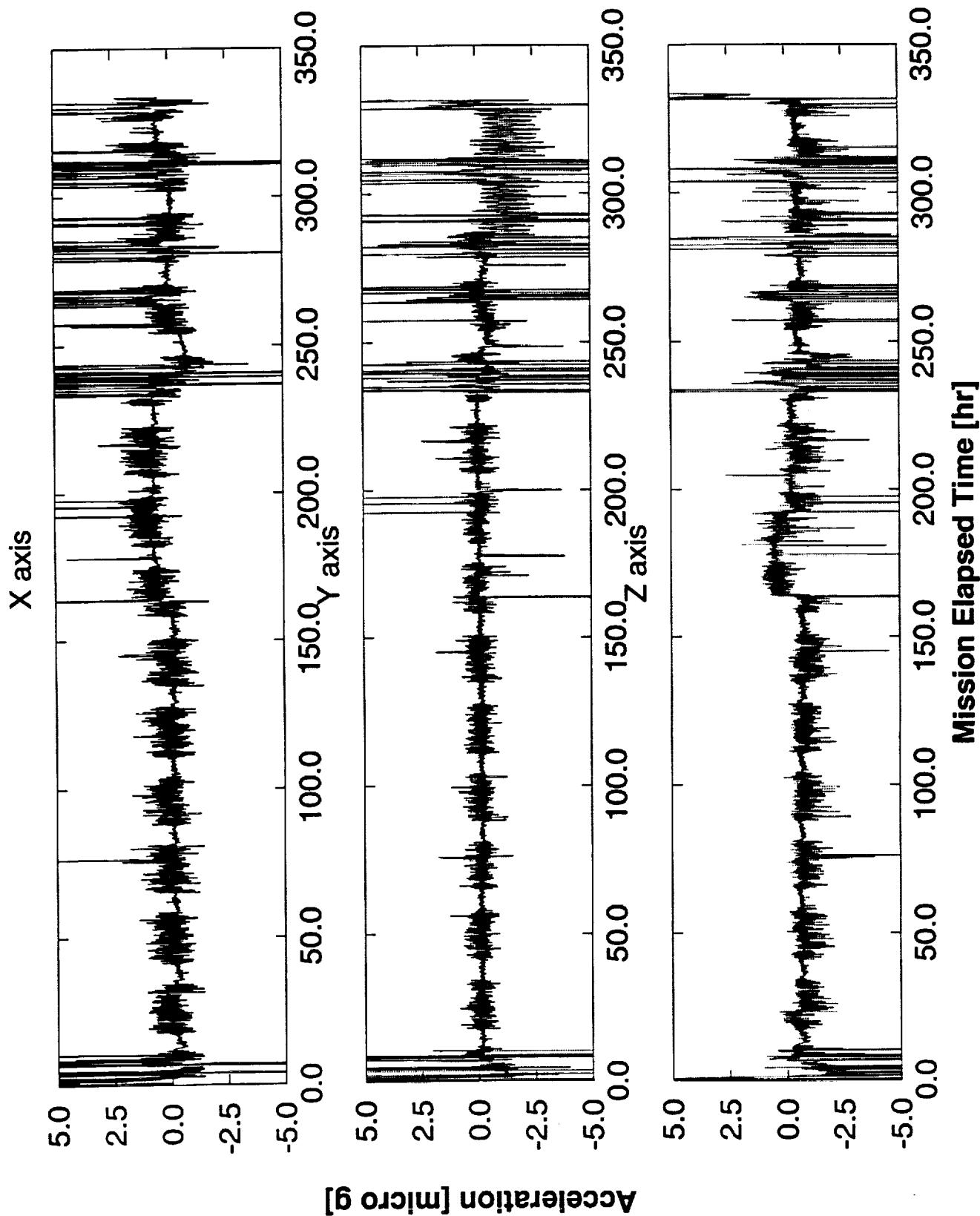


Figure 3 OARE data plotted in Orbiter body coordinate system for STS-62 mission.

SUMMARY REPORT OF MISSION ACCELERATION MEASUREMENTS FOR STS-62

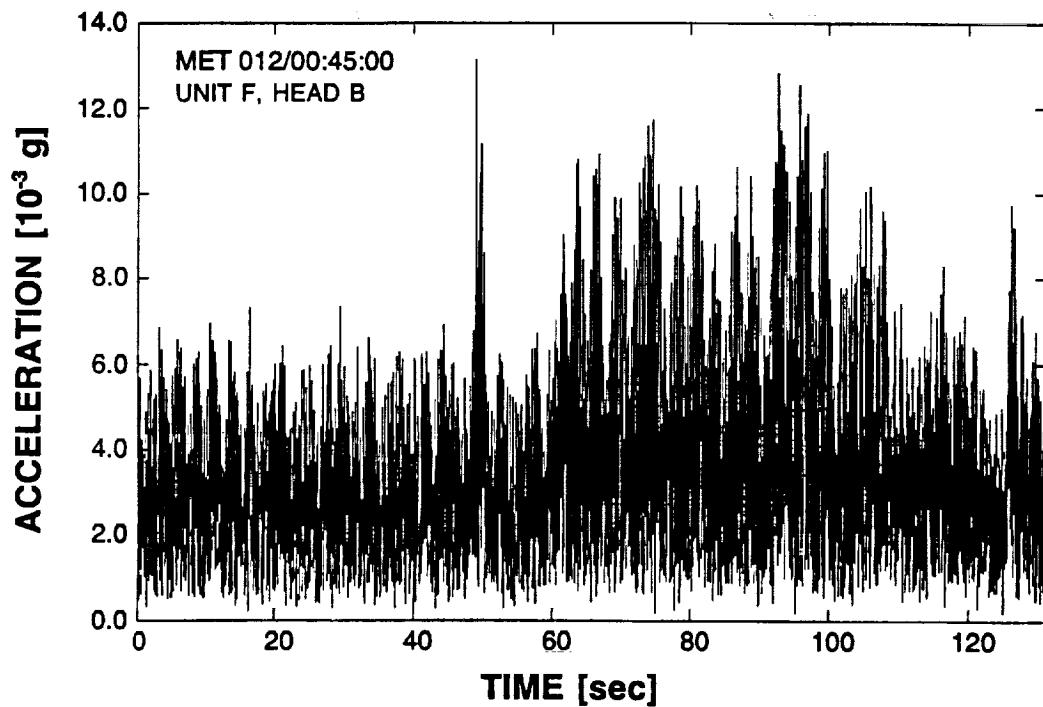


Figure 4a Time Domain vector magnitude of SAMS data for Unit F, Head B,
MET 012/00:45:00 - 012/00:47:10

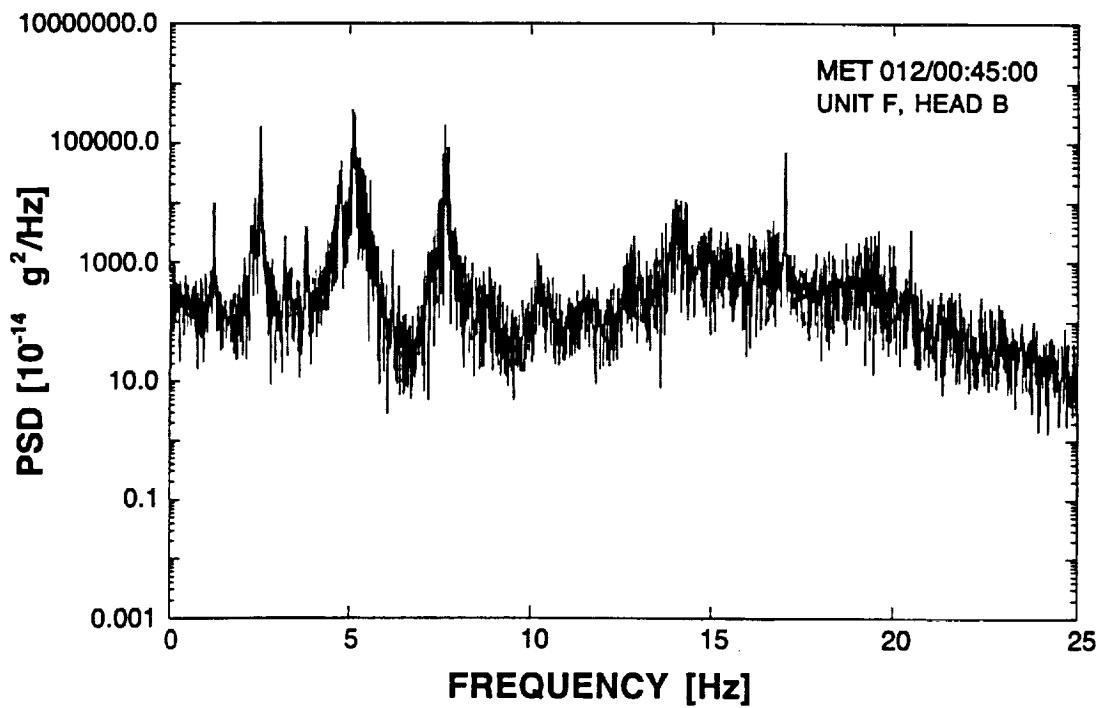


Figure 4b Power spectral density vector magnitude of SAMS data for Unit F, Head B,
MET 012/00:45:00 - 012/00:47:10

SUMMARY REPORT OF MISSION ACCELERATION MEASUREMENTS FOR STS-62

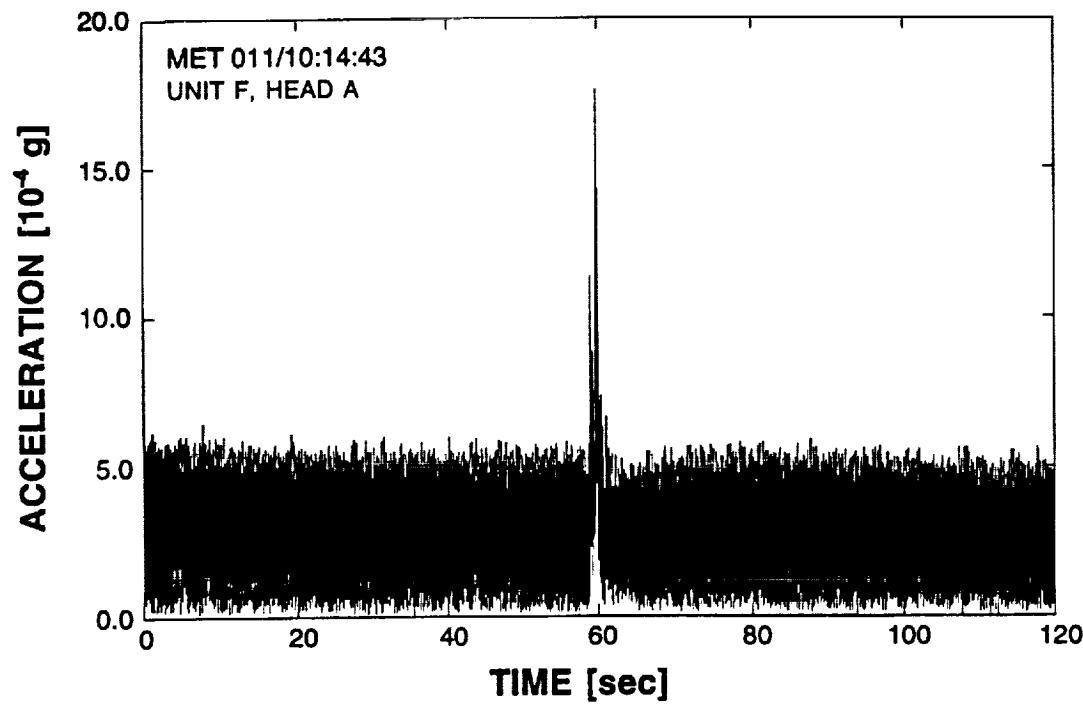


Figure 5a Time Domain vector magnitude of SAMS data for Unit F, Head A,
MET 011/10:14:43 - 011/10:16:43

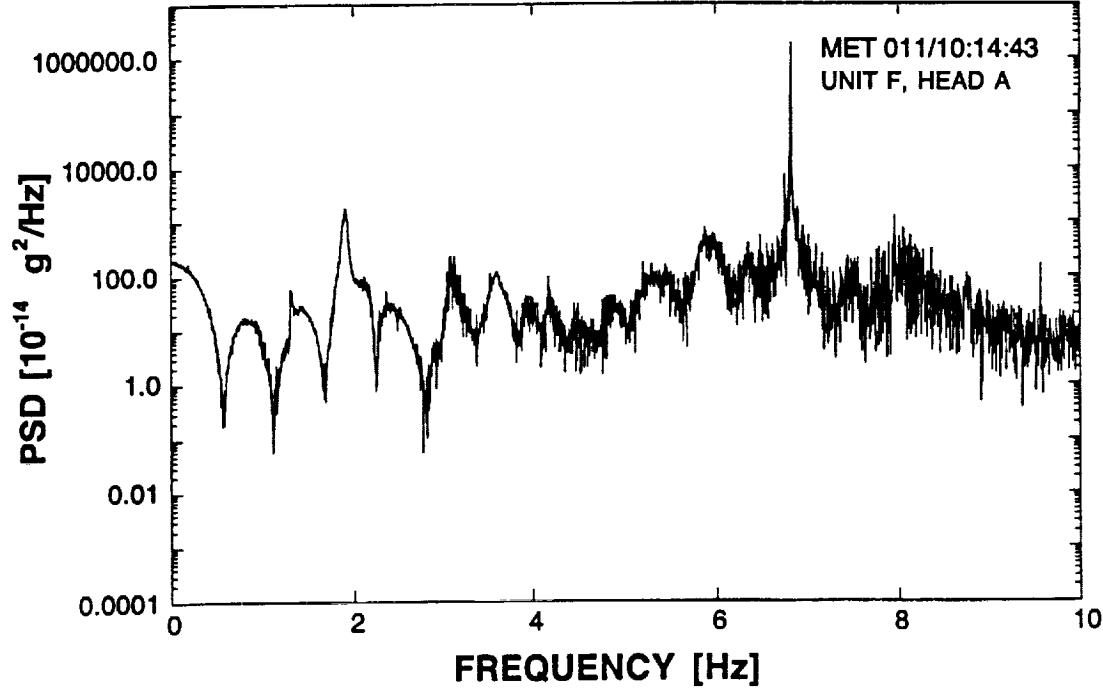


Figure 5b Power spectral density vector magnitude of SAMS data for Unit F, Head A,
MET 011/10:14:43 - 011/10:16:43

SUMMARY REPORT OF MISSION ACCELERATION MEASUREMENTS FOR STS-62

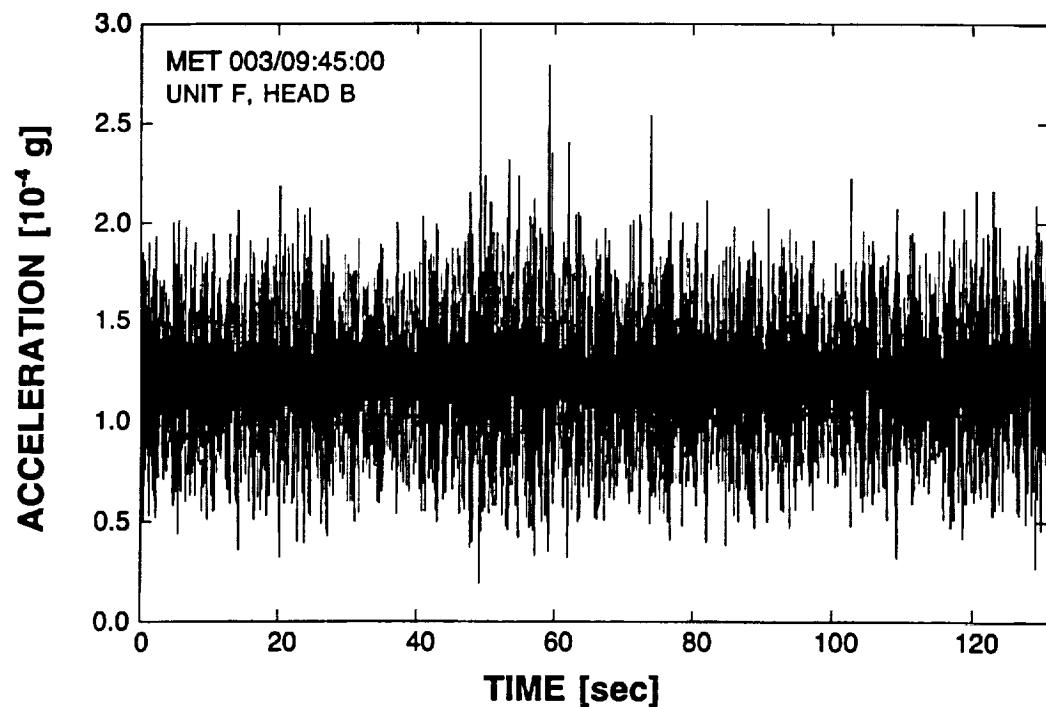


Figure 6a Time Domain vector magnitude of SAMS data for Unit F, Head B,
MET 003/09:45:00 - 003/09:47:10

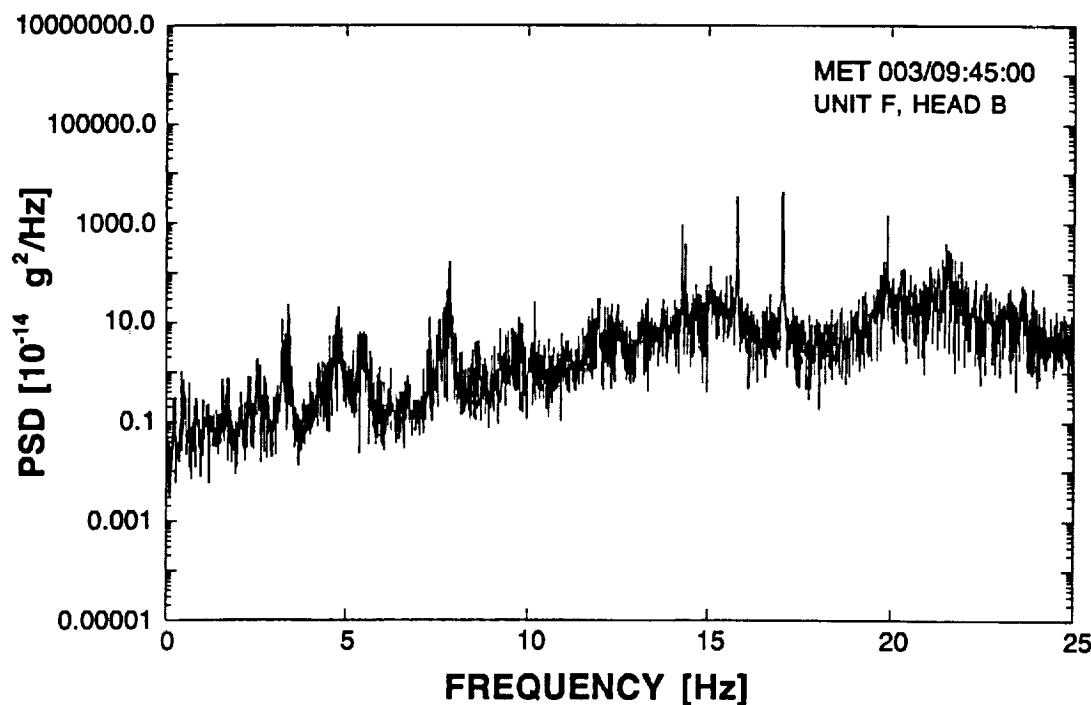


Figure 6b Power spectral density vector magnitude of SAMS data for Unit F, Head B,
MET 003/09:45:00 - 003/09:47:10

SUMMARY REPORT OF MISSION ACCELERATION MEASUREMENTS FOR STS-62

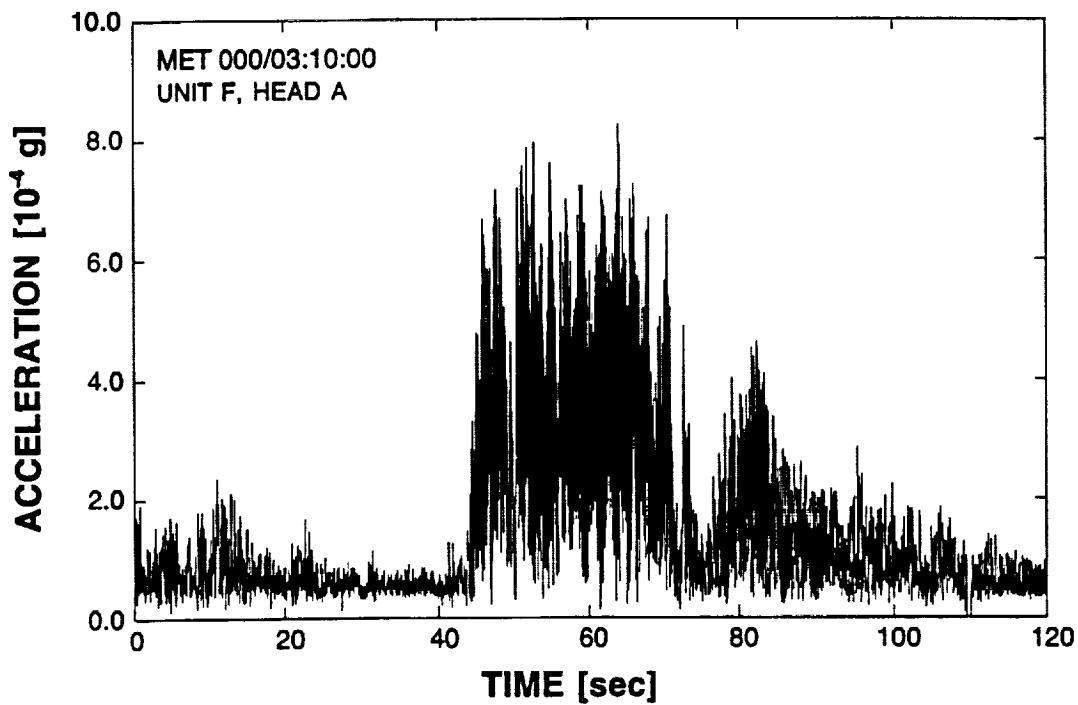


Figure 7a Time Domain vector magnitude of SAMS data for Unit F, Head A,
MET 000/03:10:00 - 000/03:12:00

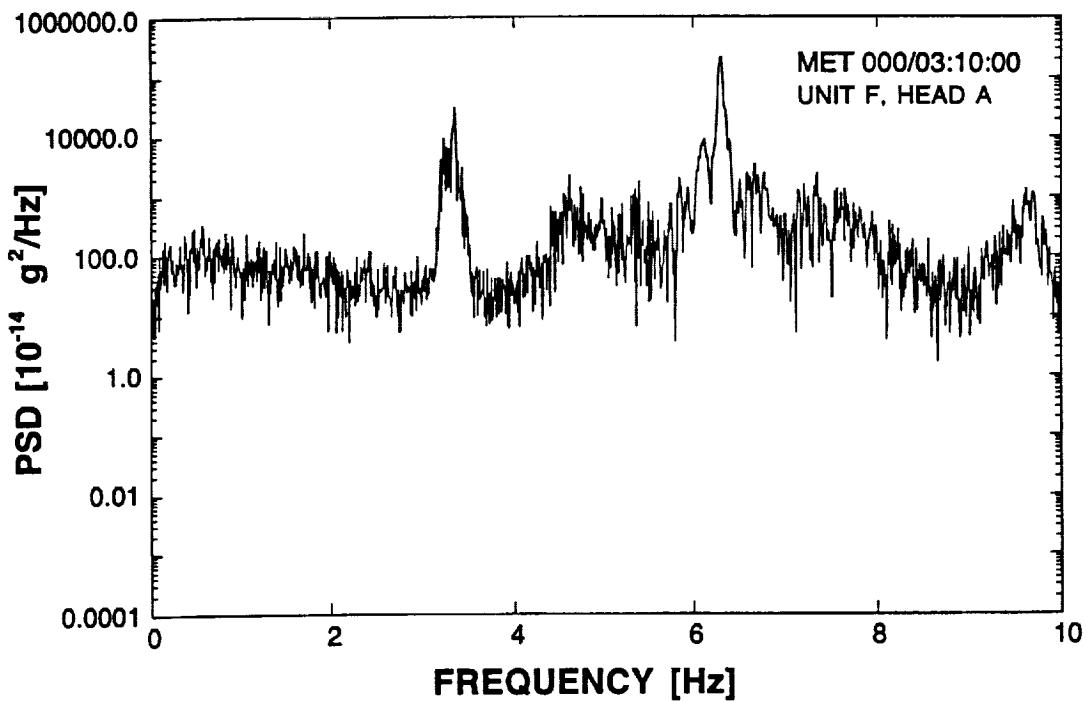


Figure 7b Power spectral density vector magnitude of SAMS data for Unit F, Head A,
MET 000/03:10:00 - 000/03:12:00

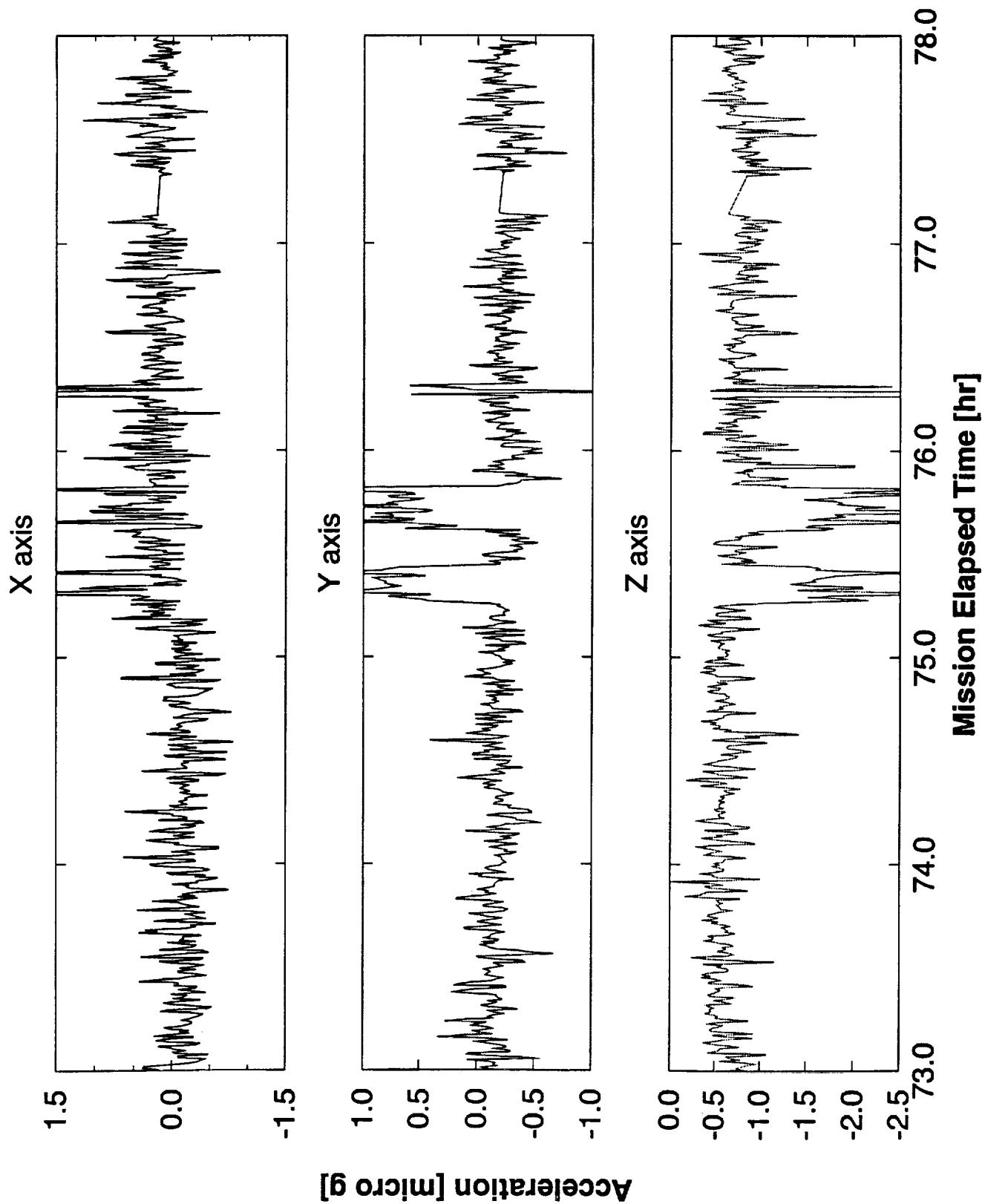


Figure 8 OARE data plotted in Orbiter body coordinate system for time period during initiation of flash evaporator system operations at MET 003/03:20.

SUMMARY REPORT OF MISSION ACCELERATION MEASUREMENTS FOR STS-62

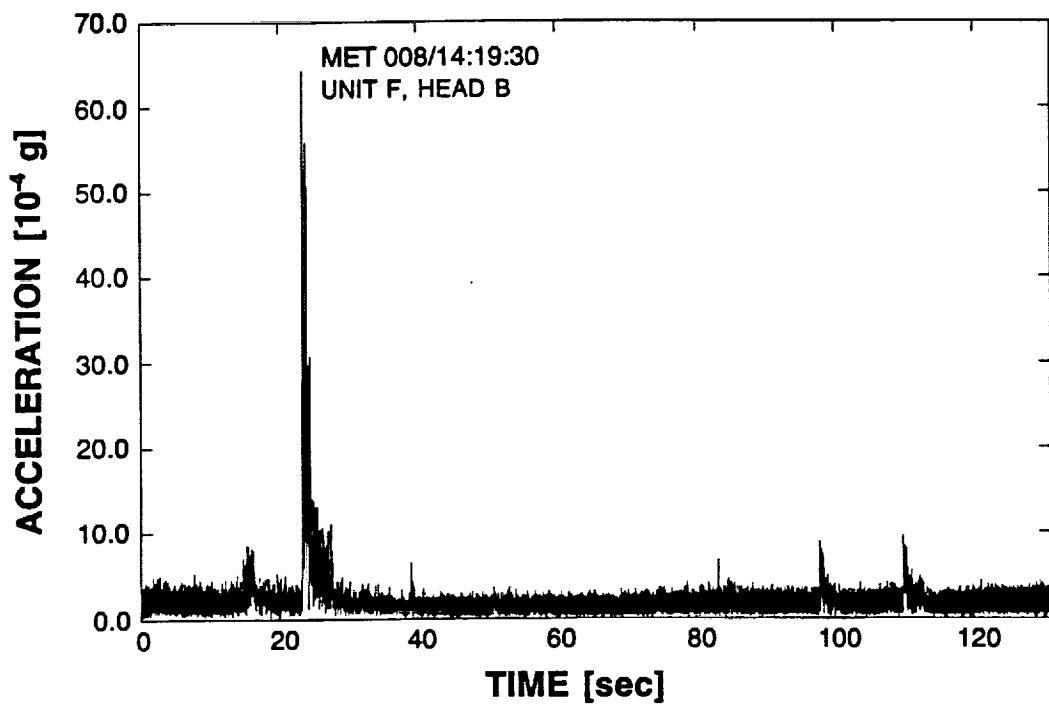


Figure 9a Time Domain vector magnitude of SAMS data for Unit F, Head B,
MET 008/14:19:30 - 008/14:21:40

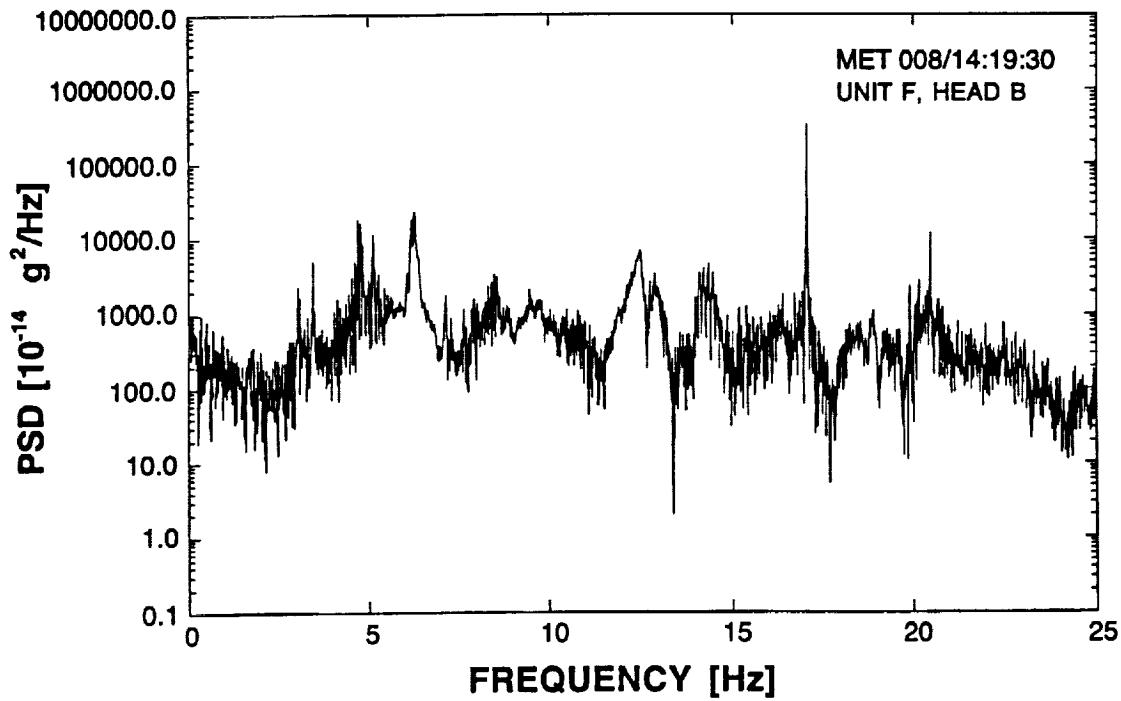


Figure 9b Power spectral density vector magnitude of SAMS data for Unit F, Head B,
MET 008/14:19:30 - 008/14:21:40

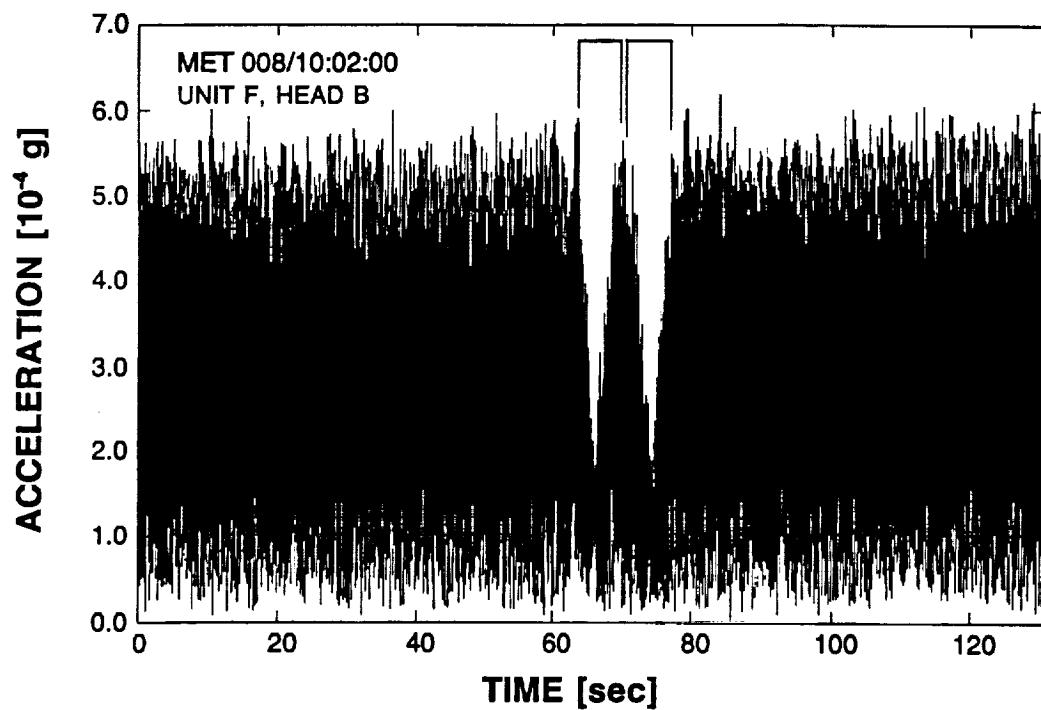


Figure 10a Time Domain vector magnitude of SAMS data for Unit F, Head B,
MET 008/10:02:00 - 008/10:04:10

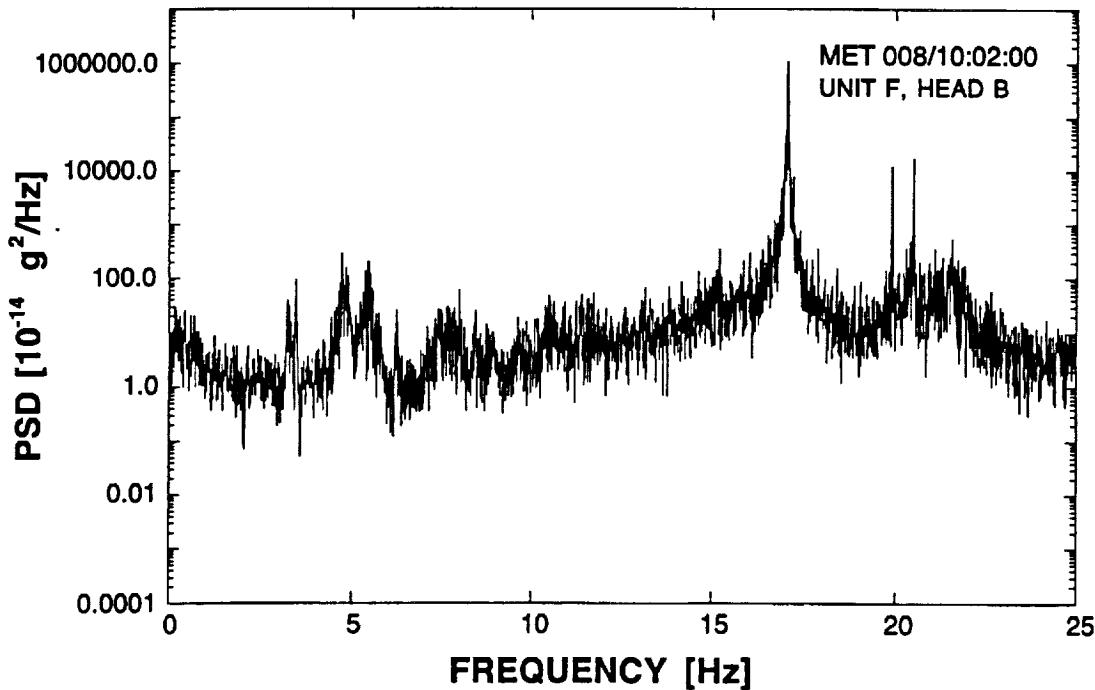


Figure 10b Power spectral density vector magnitude of SAMS data for Unit F, Head B,
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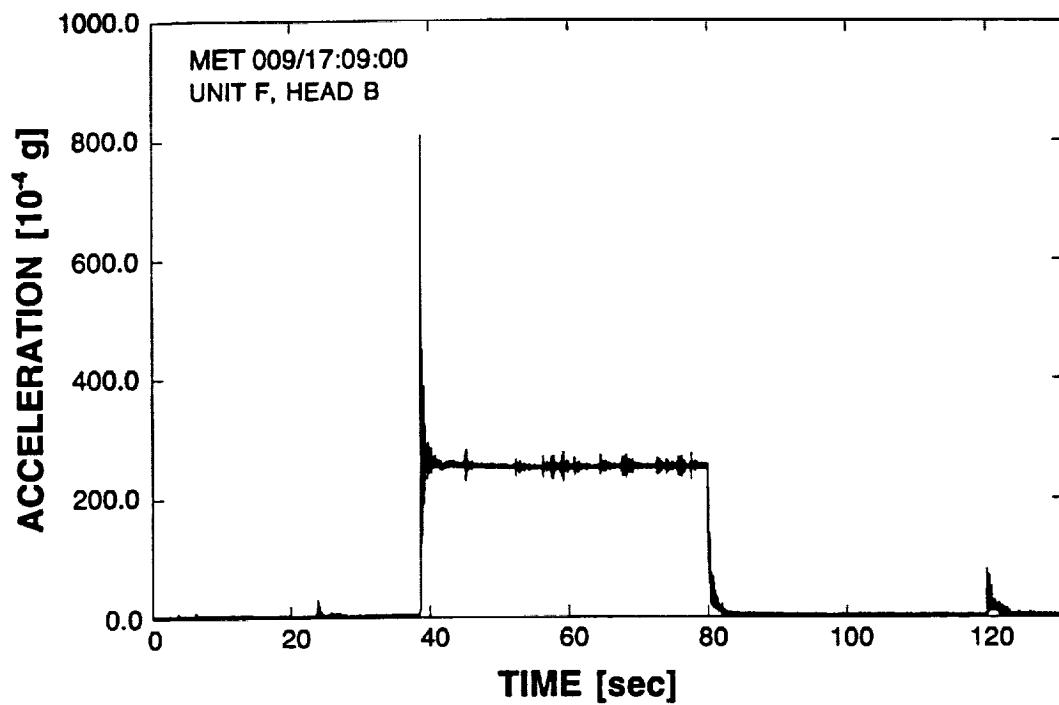


Figure 11a Time Domain vector magnitude of SAMS data for Unit F, Head B,
MET 009/17:09:00 - 009/17:11:10

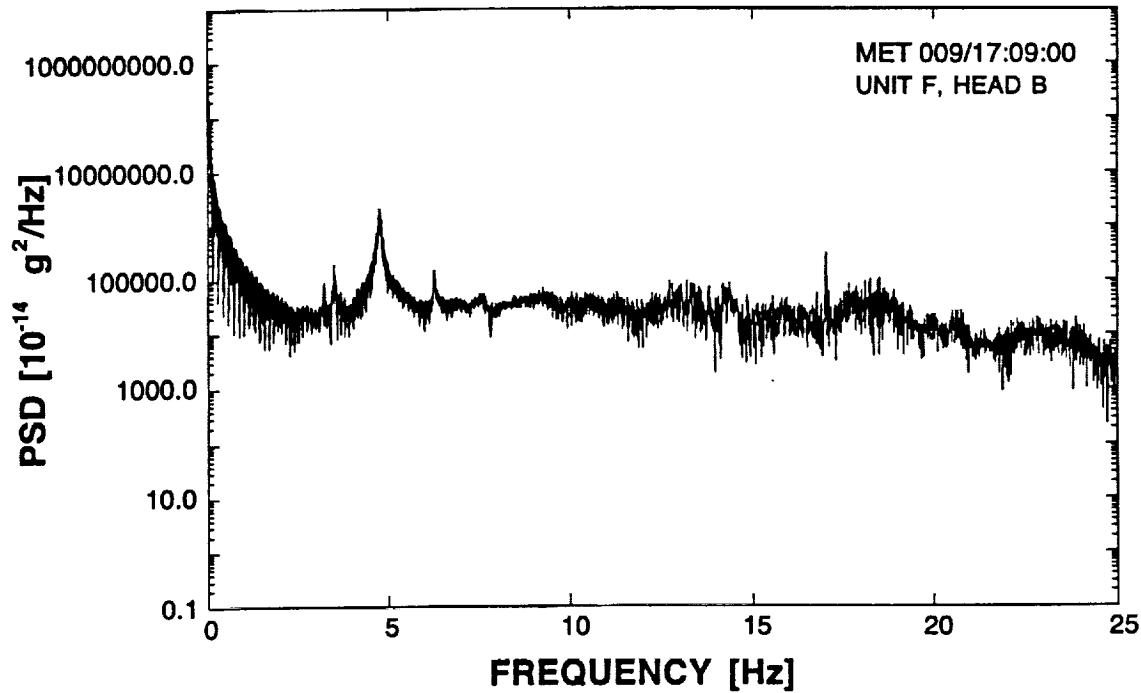


Figure 11b Power spectral density vector magnitude of SAMS data for Unit F, Head B,
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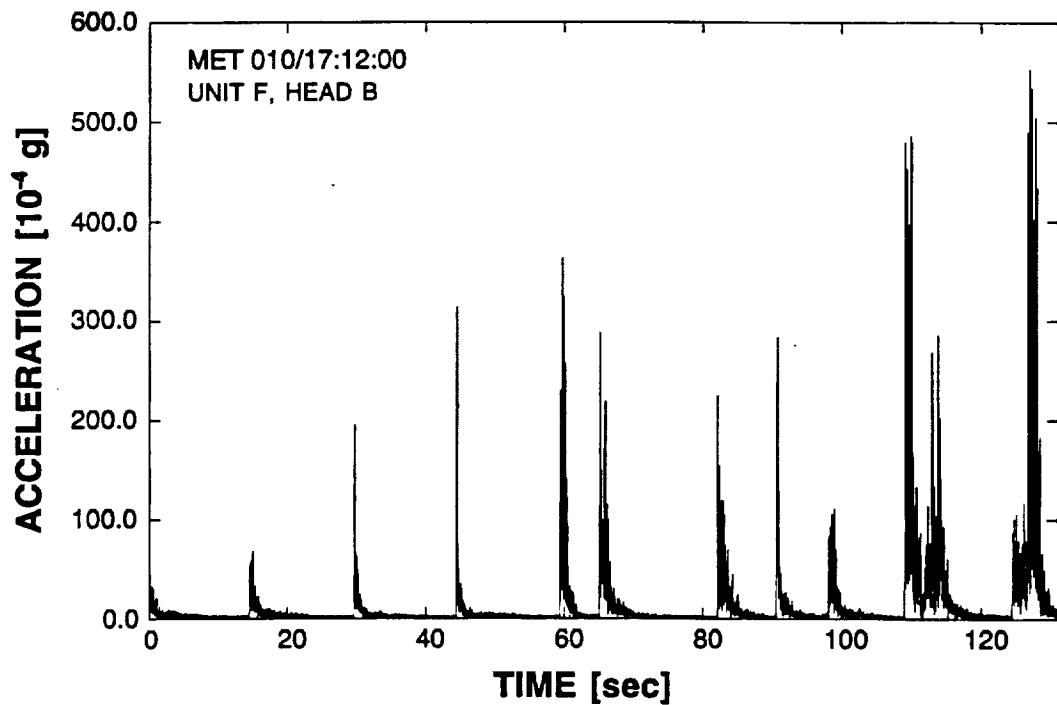


Figure 12a Time Domain vector magnitude of SAMS data for Unit F, Head B,
MET 010/17:12:00 - 010/17:14:10

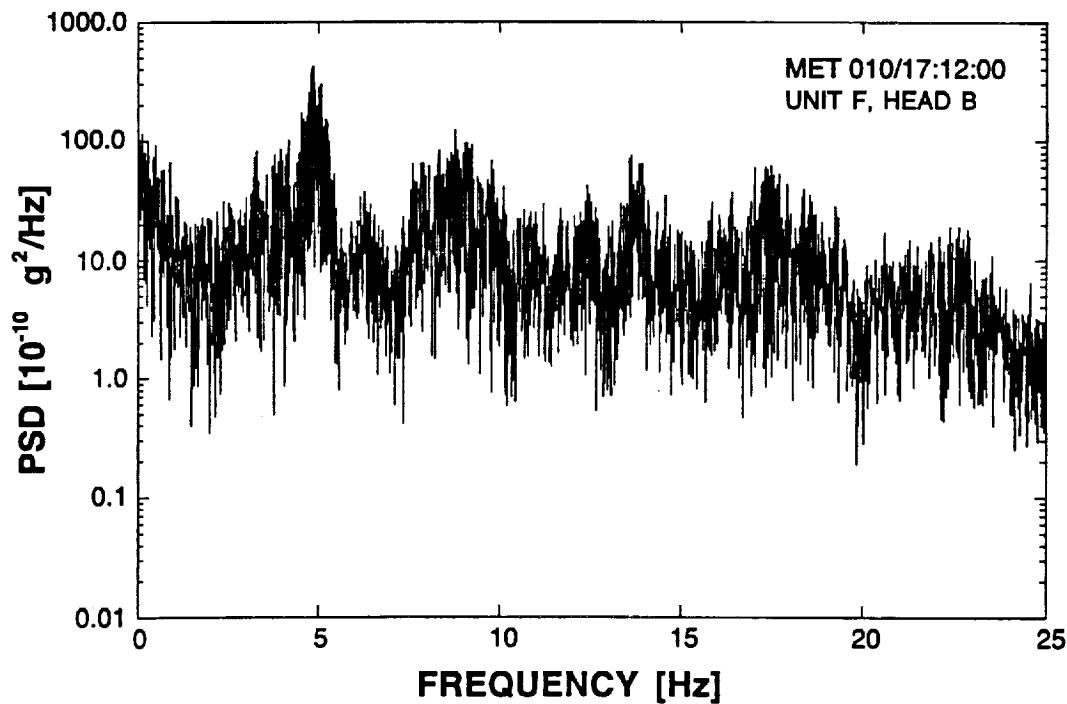
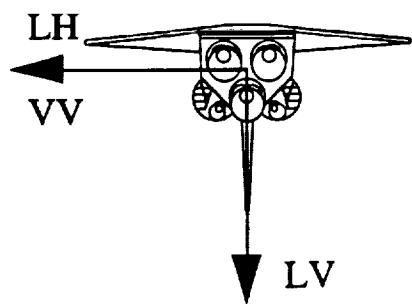
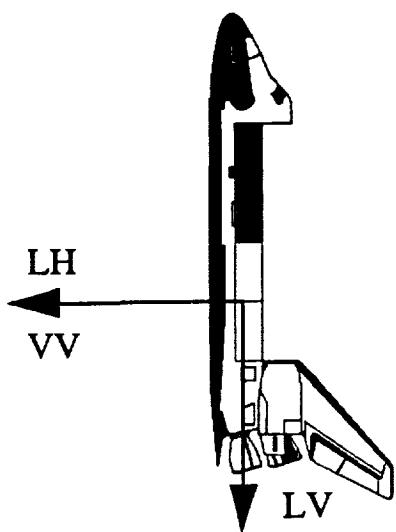


Figure 12b Power spectral density vector magnitude of SAMS data for Unit F, Head B,
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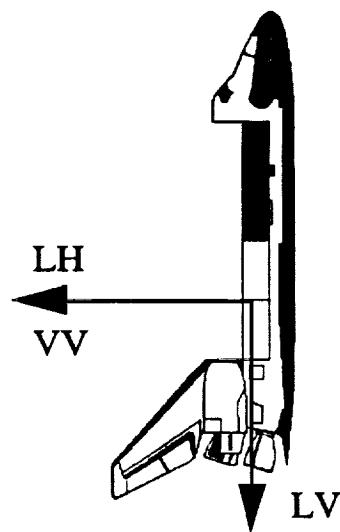
SUMMARY REPORT OF MISSION ACCELERATION MEASUREMENTS FOR STS-62



Orbiter -ZLV / +YVV Attitude



Orbiter -XLV / +ZVV Attitude



Orbiter -XLV / -ZVV Attitude

Figure 13 Orbiter Attitudes for USMP-2 on STS-62

SUMMARY REPORT OF MISSION ACCELERATION MEASUREMENTS FOR STS-62

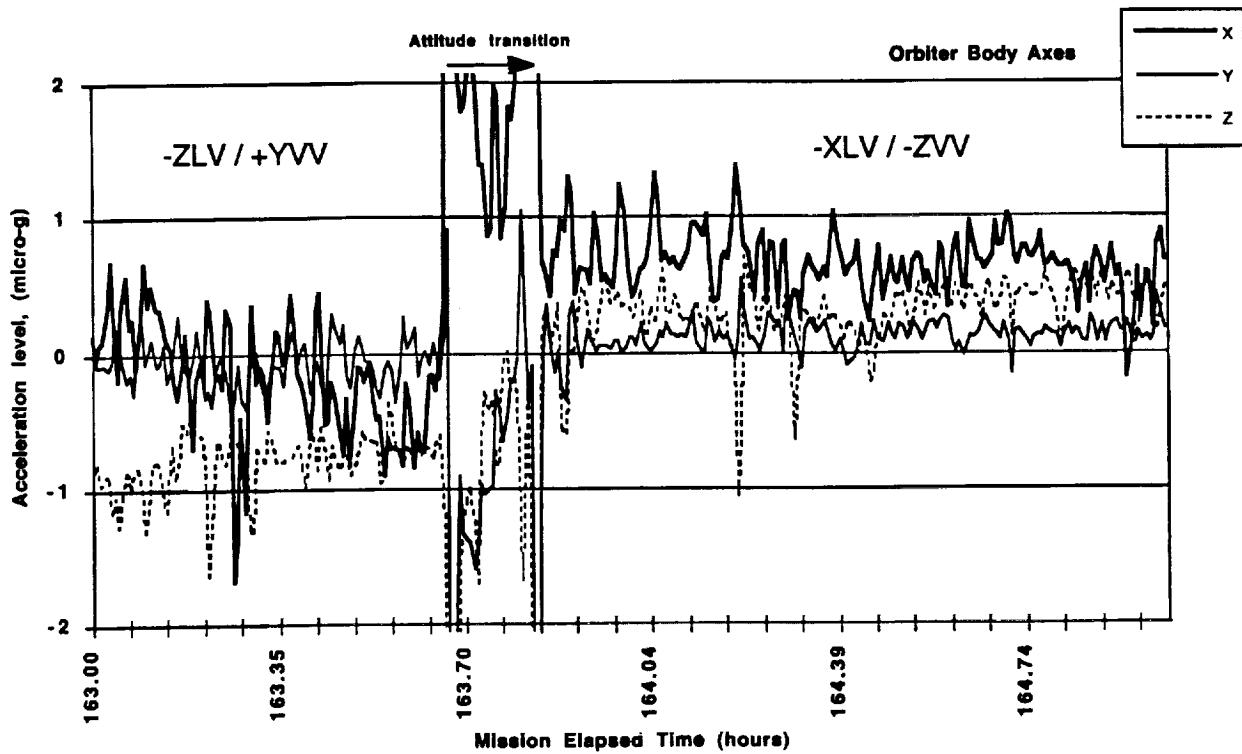


Figure 14 Attitude Transition During USMP-2 Operations (-ZLV / +YVV to -XLV / -ZVV)

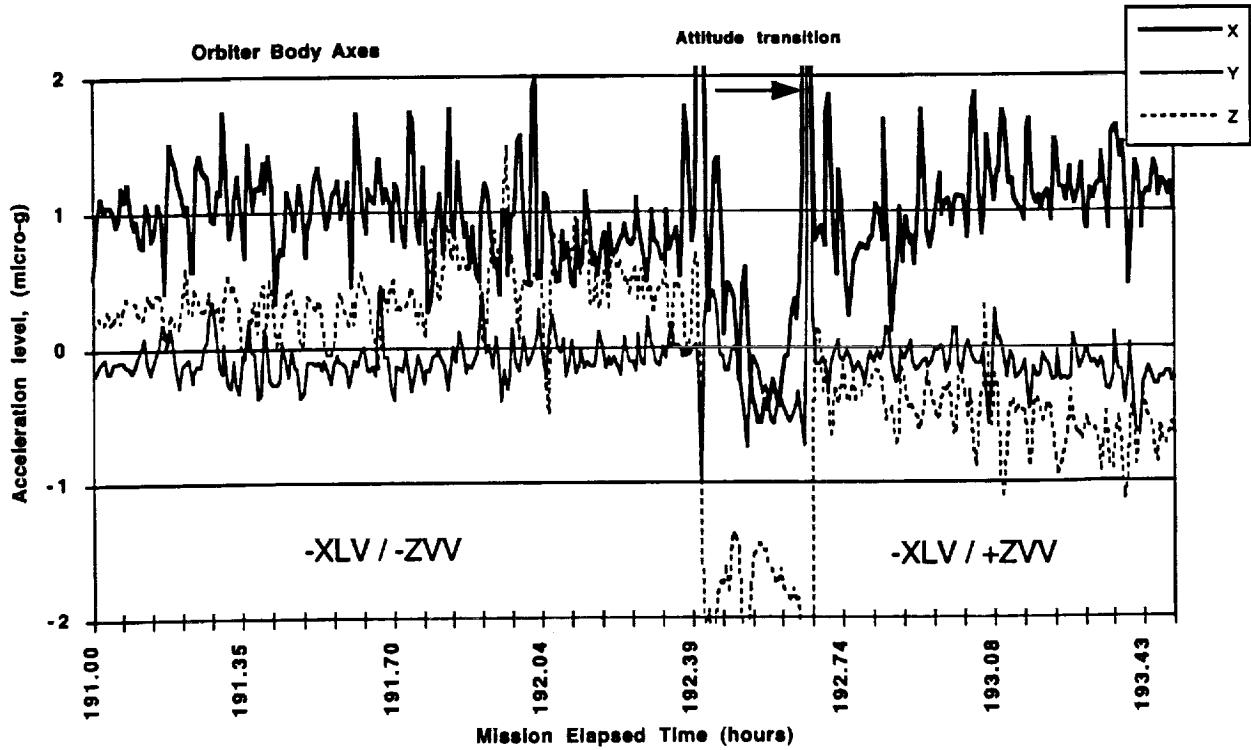


Figure 15 Attitude Transition During USMP-2 Operations (-XLV / -ZVV to -XLV / +ZVV)

USMP-2 Day 3 OARE Microgravity Environment

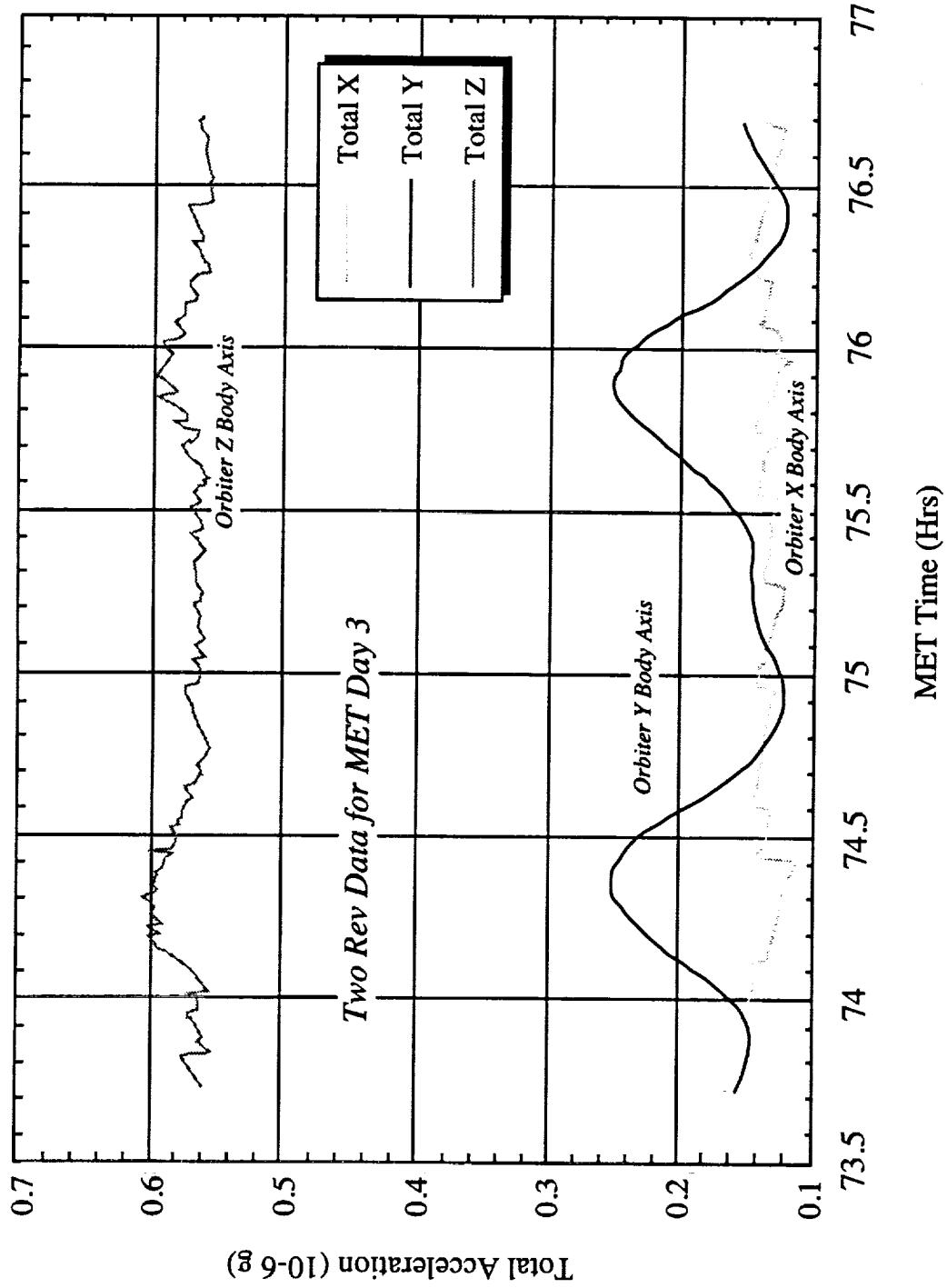


Figure 16 OARE Predicted Environment [13]

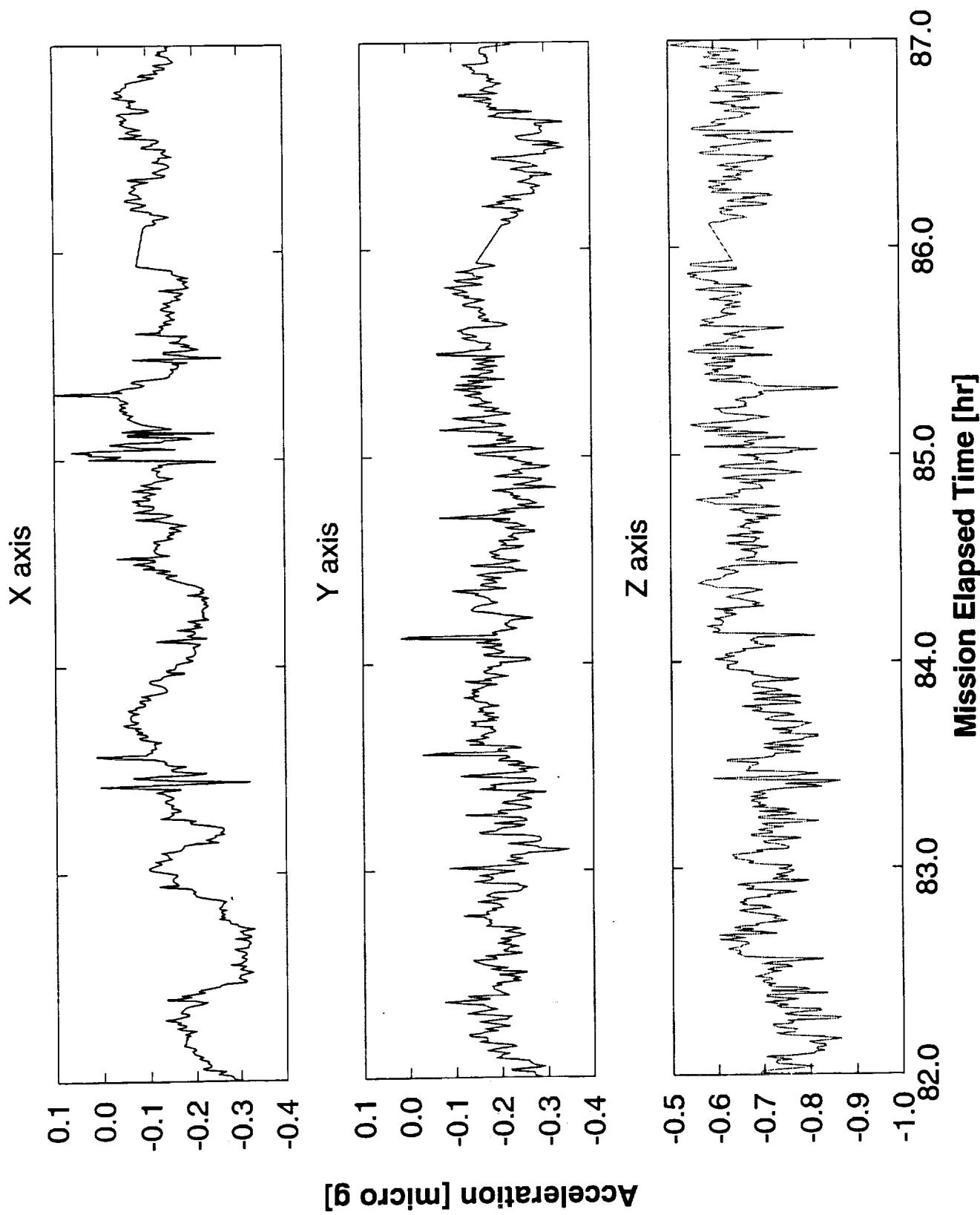


Figure 17 OARE data for a period comparable to Fig. 16.

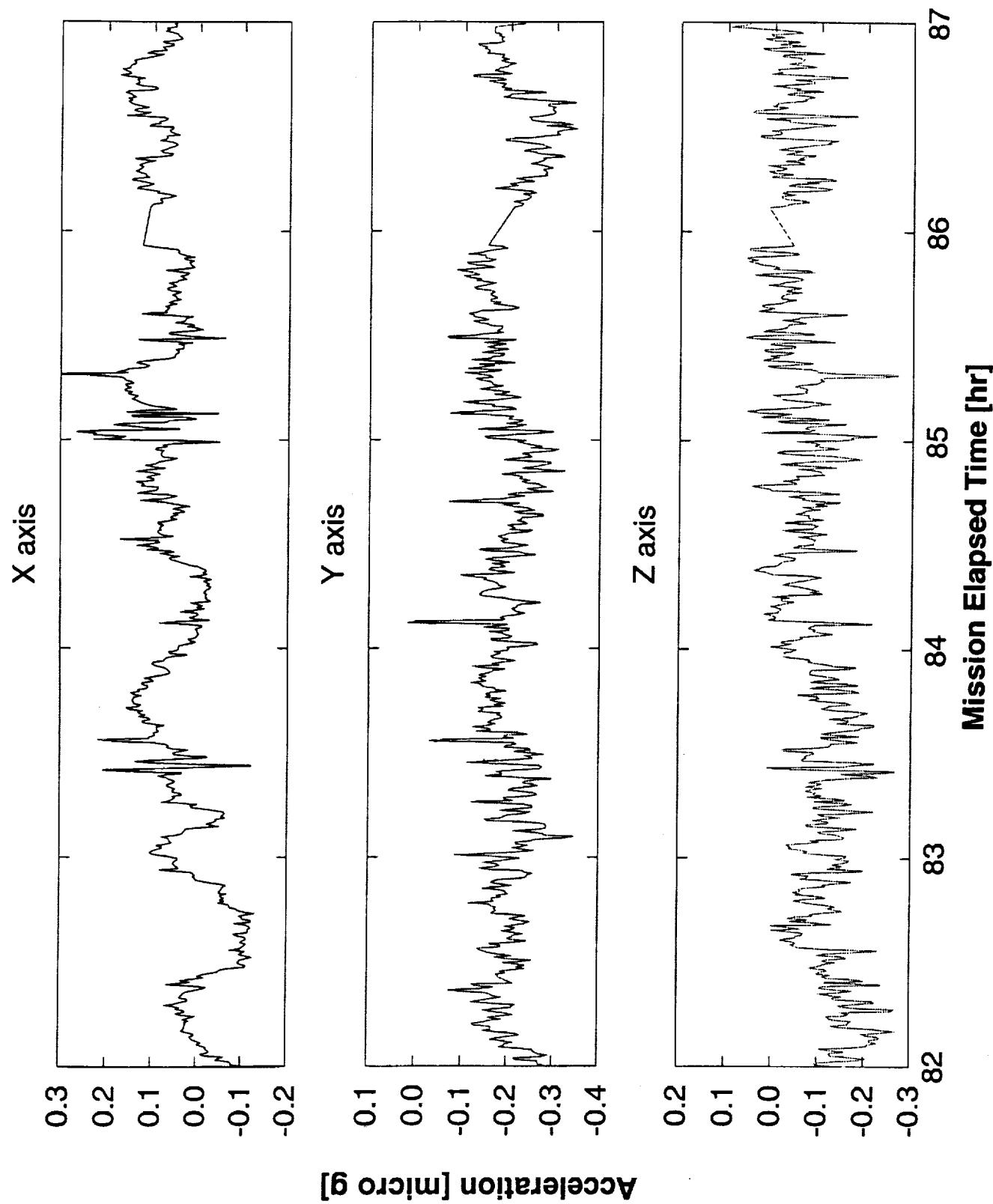


Figure 18 Quasi-steady environment at Orbiter c.g. based on recomputation of OARE data, Orbiter body coordinate system,

SUMMARY REPORT OF MISSION ACCELERATION MEASUREMENTS FOR STS-62

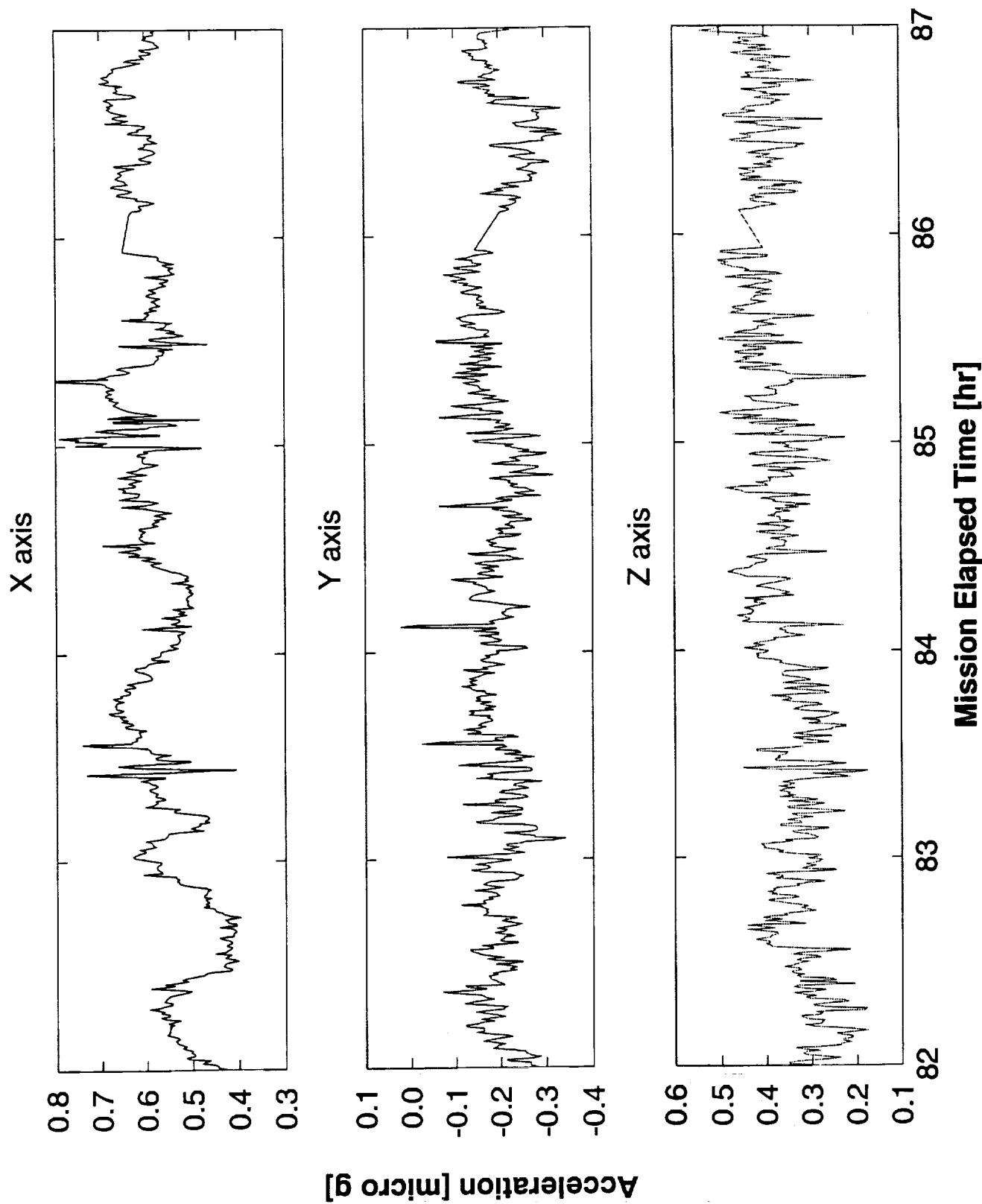


Figure 19 Quasi-steady environment at AADSF based on recomputation of OARE data, Orbiter body coordinate system.

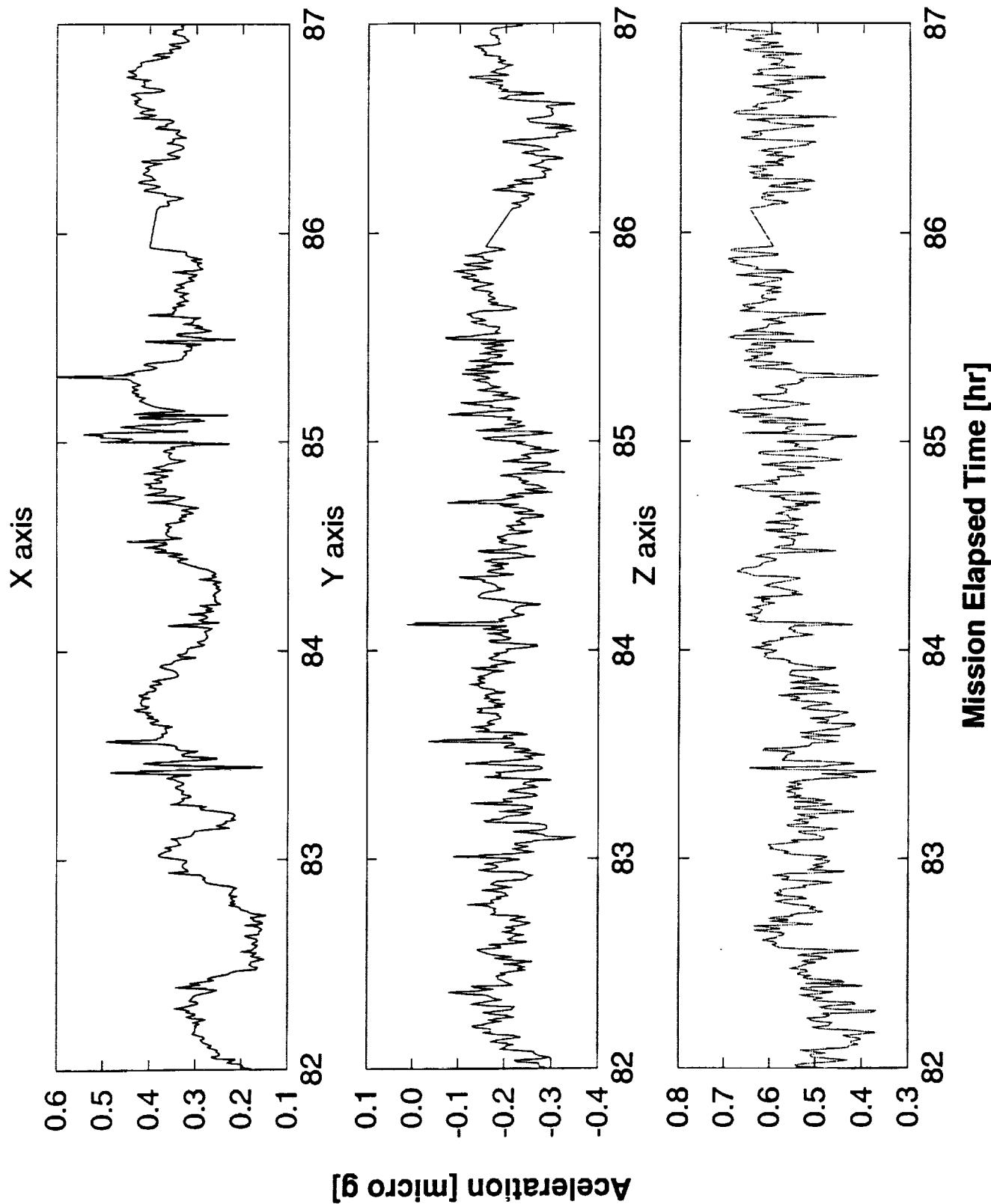


Figure 20 Quasi-steady environment at IDGE based on recomputation of OARE data, Orbiter body coordinate system.

APPENDIX A ACCESSING OARE AND SAMS DATA FILES

OARE and SAMS data files may be accessed from a file server at NASA LeRC. The NASA LeRC file server **beech.lerc.nasa.gov** (tcp/ip address 139.88.19.43) can be accessed via anonymous ftp, as follows

ftp 139.88.19.43

login anonymous

password guest

cd pub

ls (This will list files and directories under pub. OARE and SAMS data are organized within mission directories: usml1, usmp1, etc.)

The SAMS data files are organized in a tree-like structure as pictured in Figure A1. Files are broken down into categories based upon sensor head, mission day, and type of data. Files are stored at the lowest level in the tree, and the data file name reflects the contents of the file. For example, axm00102.15r contains data for sensor head a, the x axis, m means MET (if n, time has been converted into MET), day 001, hour 02, 1 of 5 files and r means reduced (temp/gain compensation applied). The file **readme.doc** provides a comprehensive description and guide to the data.

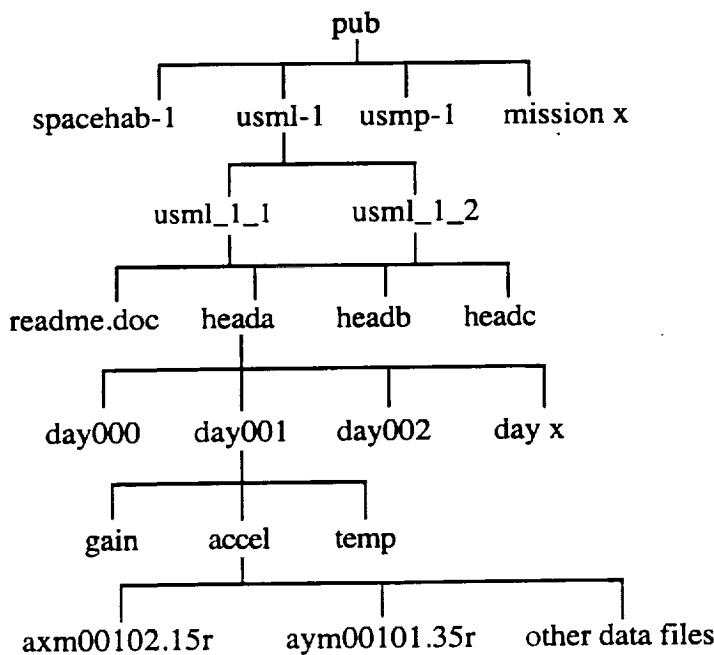


Figure A1 SAMS Data Directory Tree

SUMMARY REPORT OF MISSION ACCELERATION MEASUREMENTS FOR STS-62

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APPENDIX B SAMS TIME HISTORIES

Accelerometer data collected on Orbiter missions are generally analyzed by the PI or experiment team responsible for the system. The PI Microgravity Services (PIMS) project at the NASA Lewis Research Center was formed in part to support microgravity PI's in the evaluation of acceleration effects on their experiments and to characterize the vibrational environment of the microgravity carriers and vehicles. The primary continual source of accelerometer data from mission to mission is SAMS. Some of the SAMS data from STS-62 are presented in Appendices B and C to provide PI's with an overview of the environment during the mission.

The raw data recorded by SAMS is processed to compensate for temperature and gain related errors of bias, scale factor, and axis misalignment. The processing utilizes a fourth order temperature model to compensate the data and convert the raw digitized data into engineering units (Thomas, et al., 1992). The data are transformed to the shuttle structural coordinate system and formatted into files for distribution via CD-ROM and file server. See Appendix A for information on file server access to SAMS data.

The compensated data are further processed to produce the plots shown here. Two time history representations of the data are provided: ten second average and ten second root mean square (rms) plots. These calculations are presented in two hour plots with the corresponding average and rms plots on one page. The ten second average plots should be used to identify times when the steady level of the acceleration signal deviates from the background level. The ten second rms plots should be used to identify times when oscillatory and/or transient deviations from the background acceleration levels occurred.

Average and Root Mean Square Calculations

The average plots were produced using STS-62 SAMS Unit F, Head B data. Unit F, Head B data were collected at 125 samples per second and a 25 Hz low pass filter was applied to the data by the SAMS unit prior to digitization. The plots were produced by first forming the vector magnitude of the x, y, z axis data and then taking the average of consecutive ten second intervals of data. The average produces one data point for every ten seconds ($N = 1250$ points) of data. The following equation was used to calculate the ten second moving window average:

$$\text{Average} = \frac{1}{N} \sum_{j=1}^N V_j$$

where V is the vector magnitude of the x, y, and z axis data.

SUMMARY REPORT OF MISSION ACCELERATION MEASUREMENTS FOR STS-62

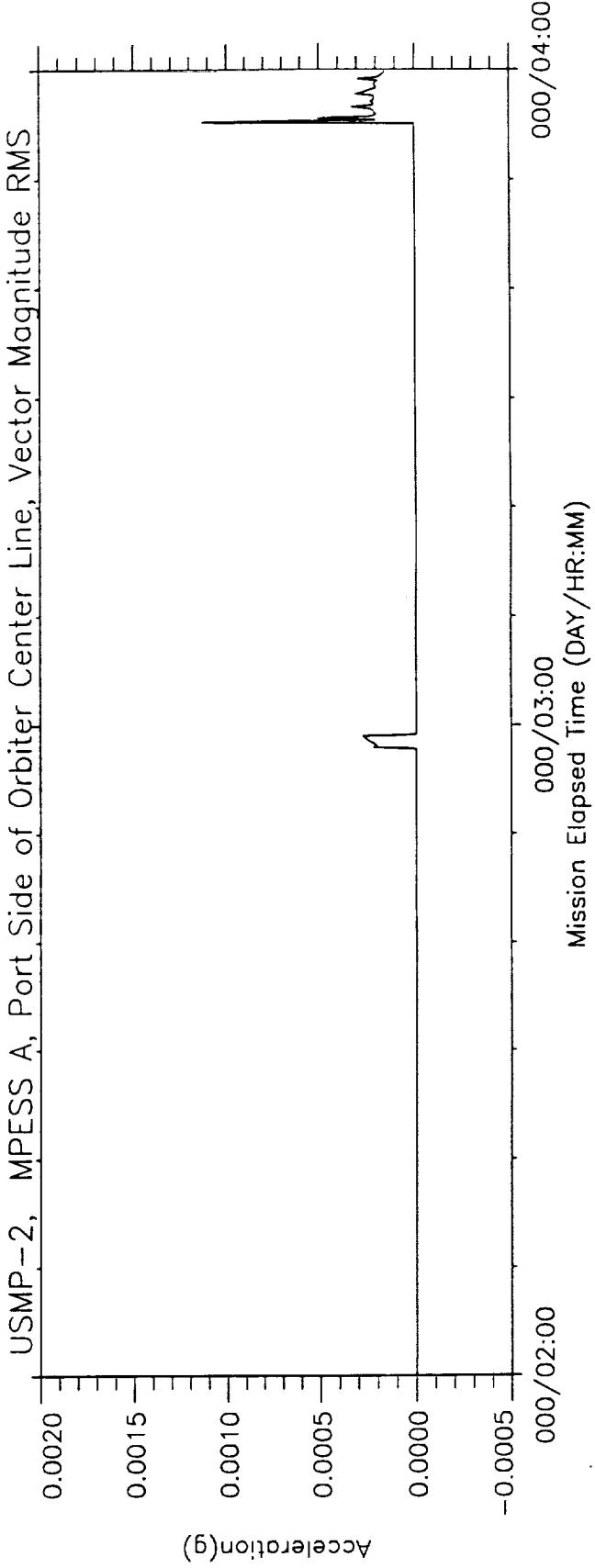
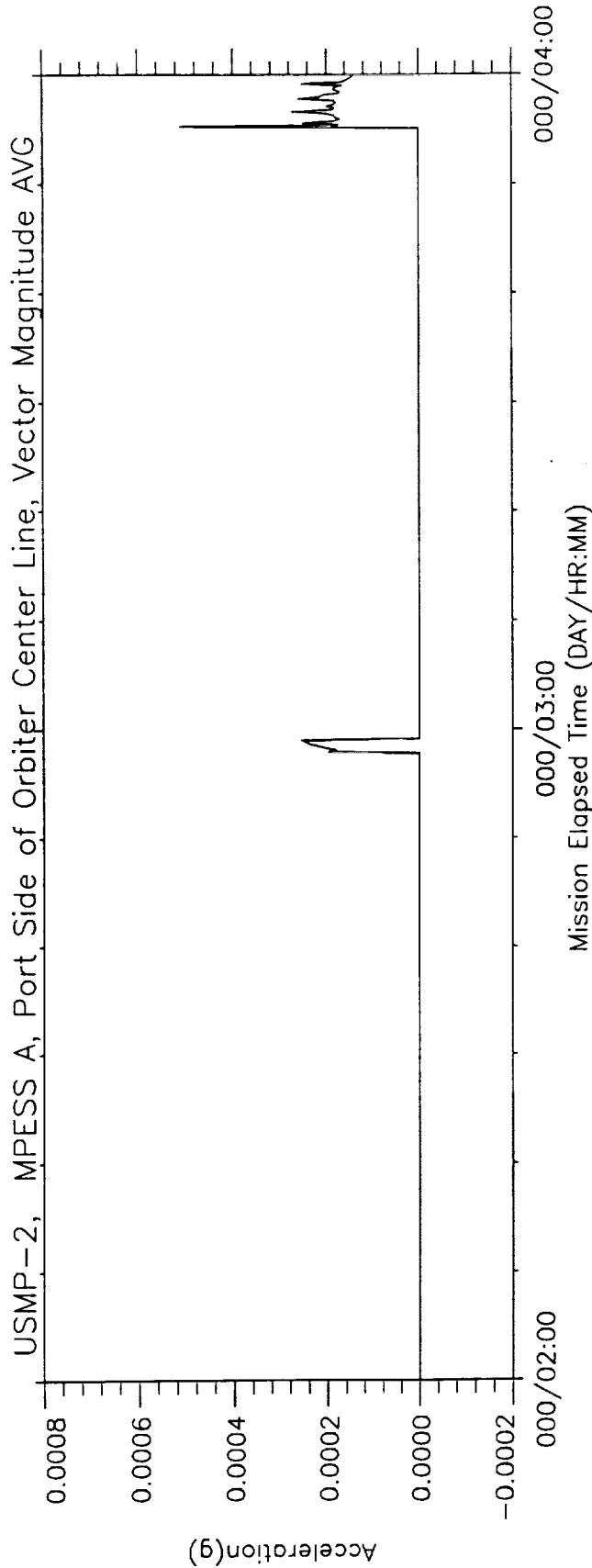
The rms plots were produced by taking the rms of 10 second intervals for the two hour period. The root mean square of a discrete time series for 10 seconds was calculated using the following equation:

$$rms = \sqrt{\left(\frac{1}{N} \sum_{j=1}^N V_j^2 \right)}$$

References

Thomas, J. E., R. B. Peters, and B. D. , Finley, Space Acceleration Measurement System triaxial head error budget NASA Technical Memorandum -105300, January 1992.

SUMMARY REPORT OF MISSION ACCELERATION MEASUREMENTS FOR STS-62

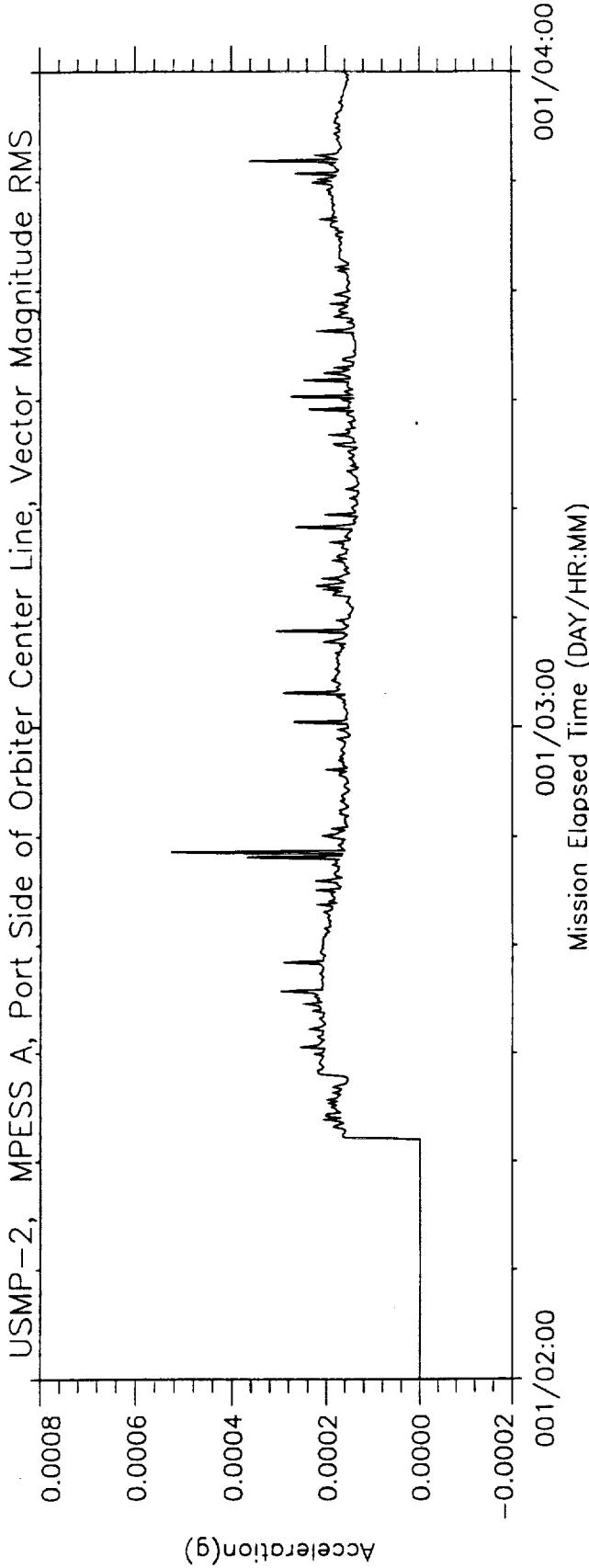
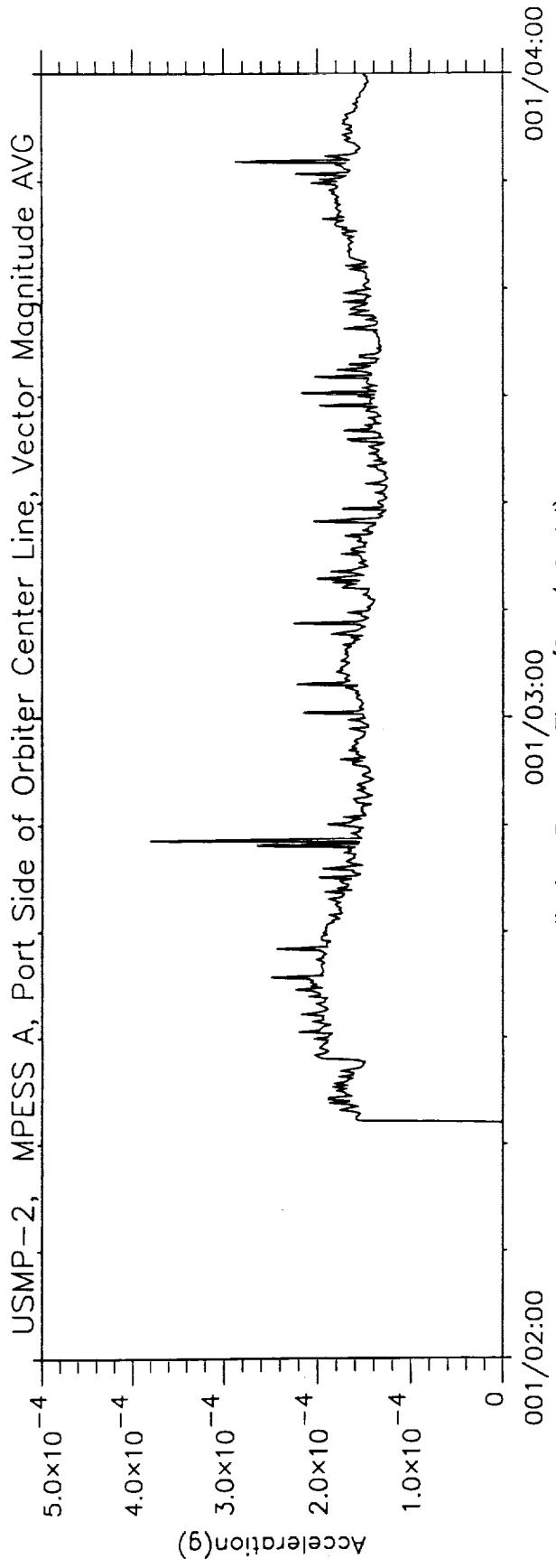


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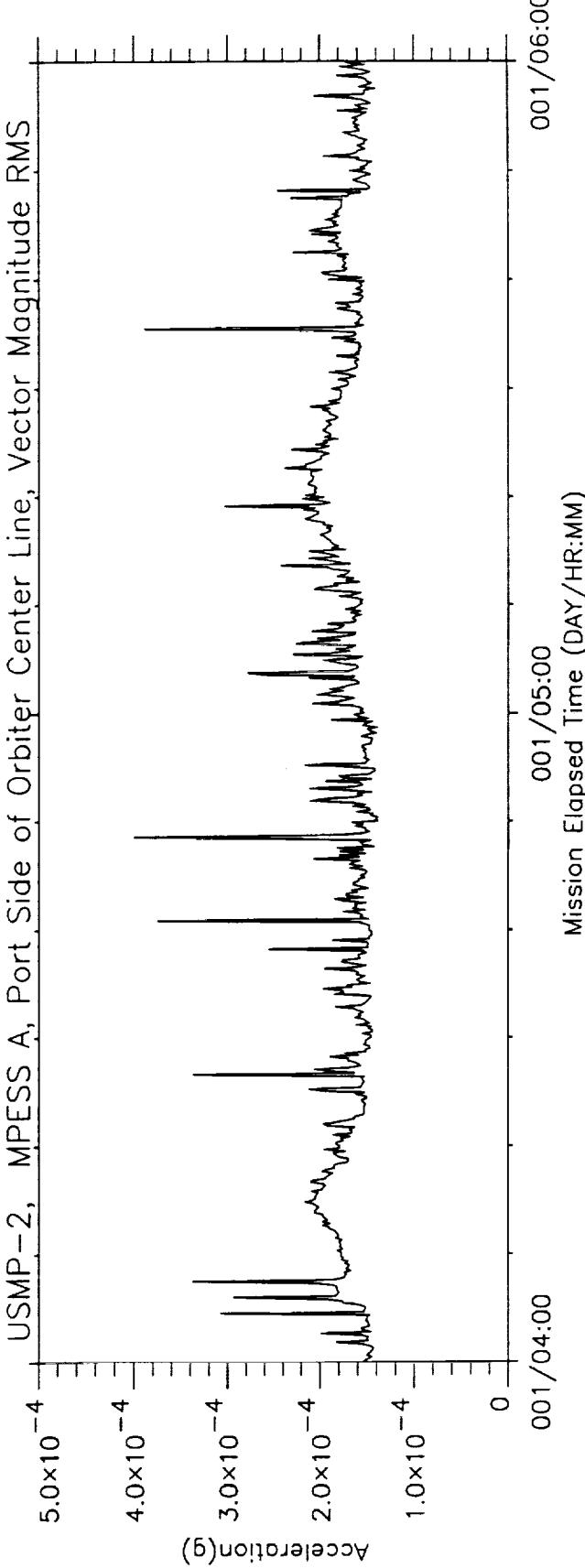
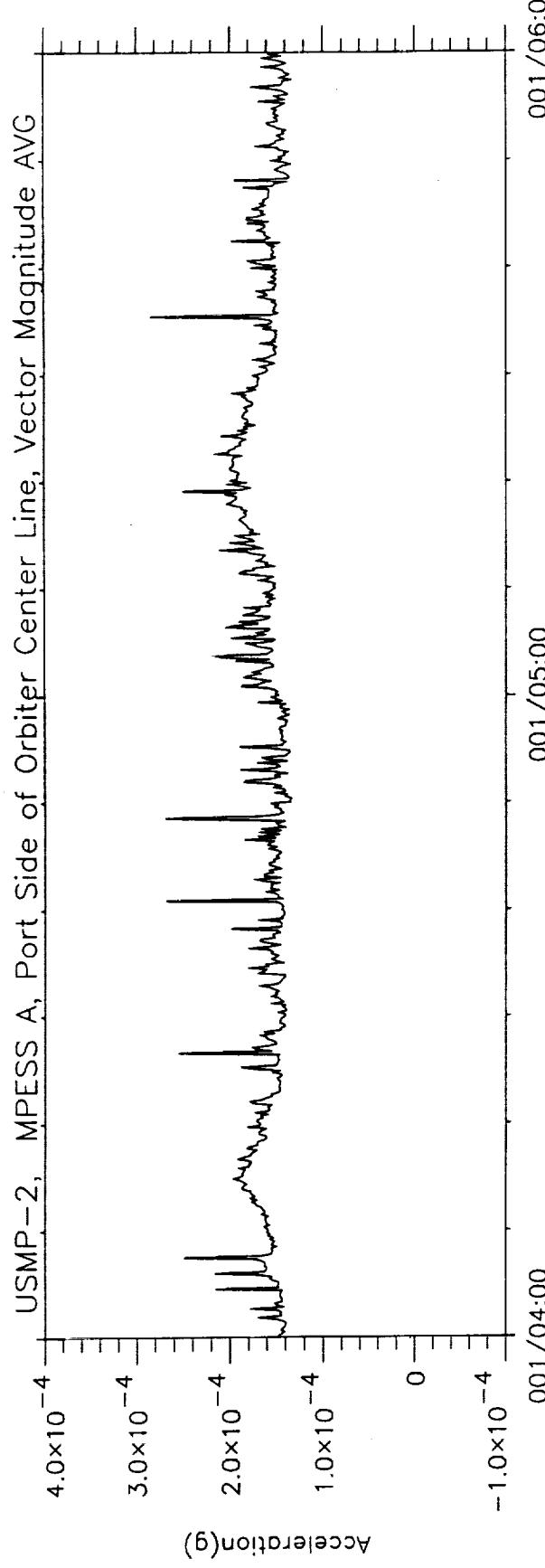
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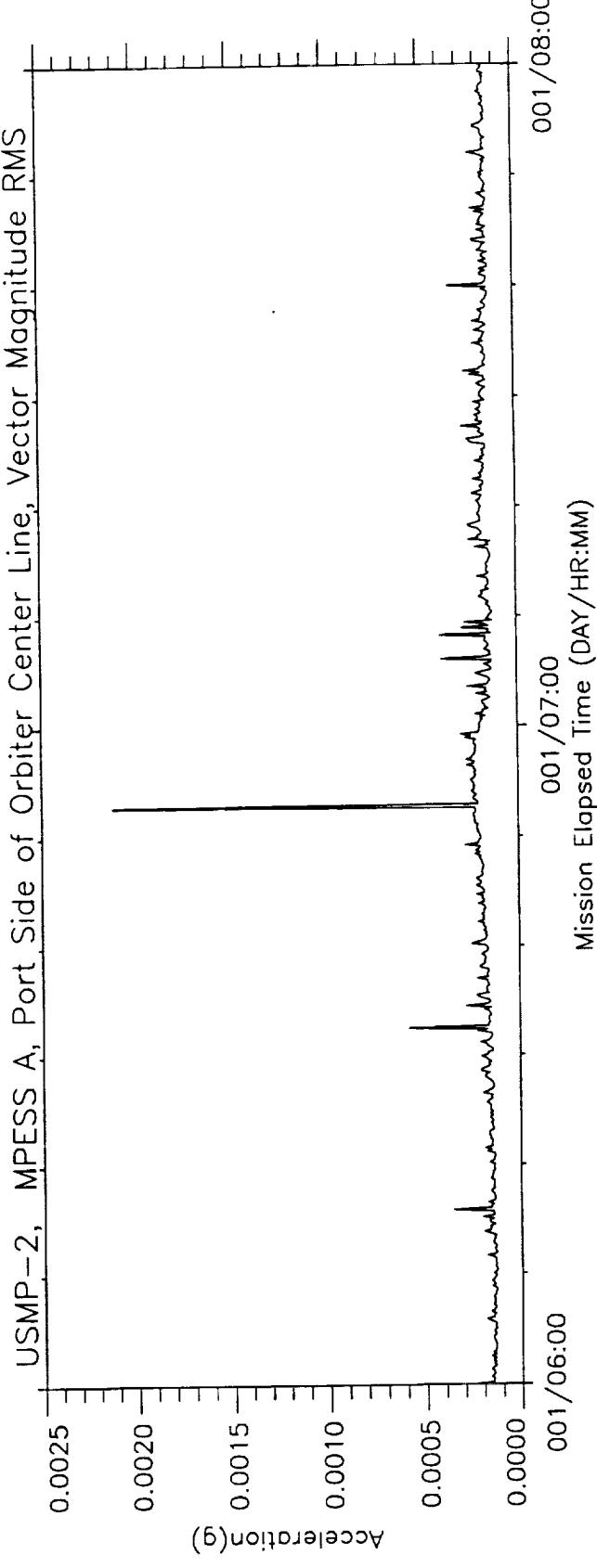
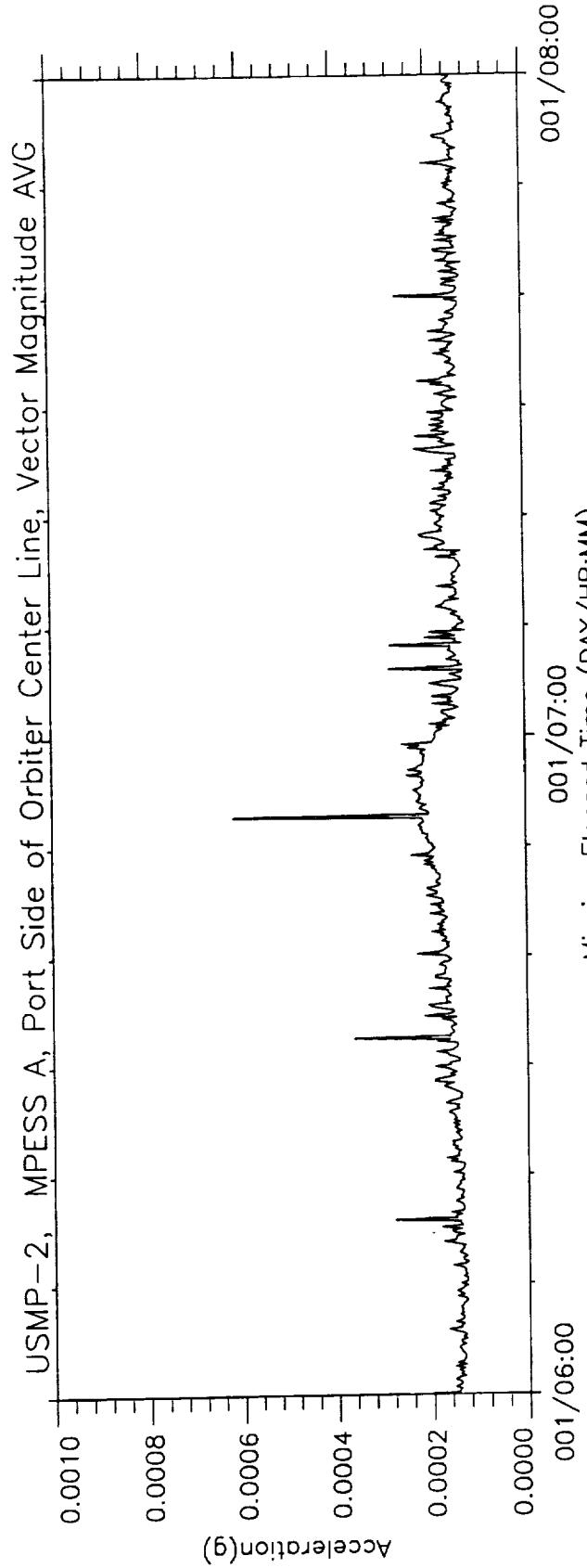
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SUMMARY REPORT OF MISSION ACCELERATION MEASUREMENTS FOR STS-62



SUMMARY REPORT OF MISSION ACCELERATION MEASUREMENTS FOR STS-62

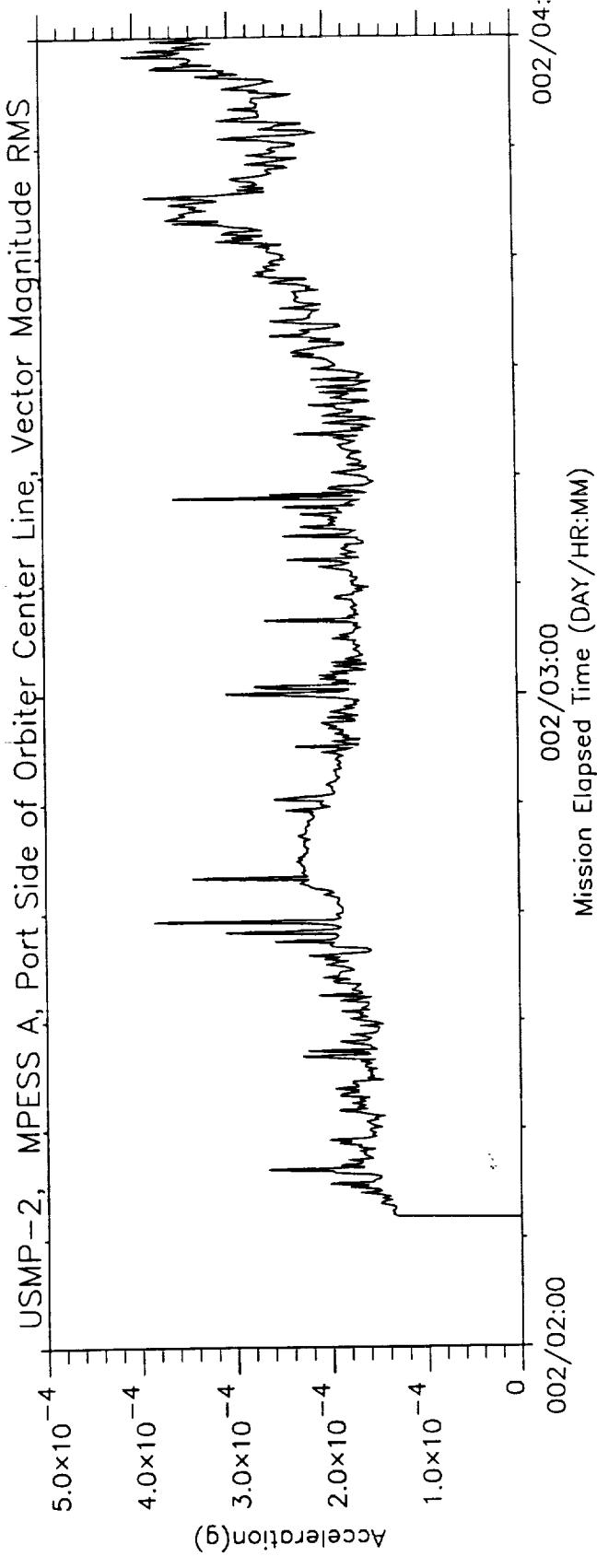
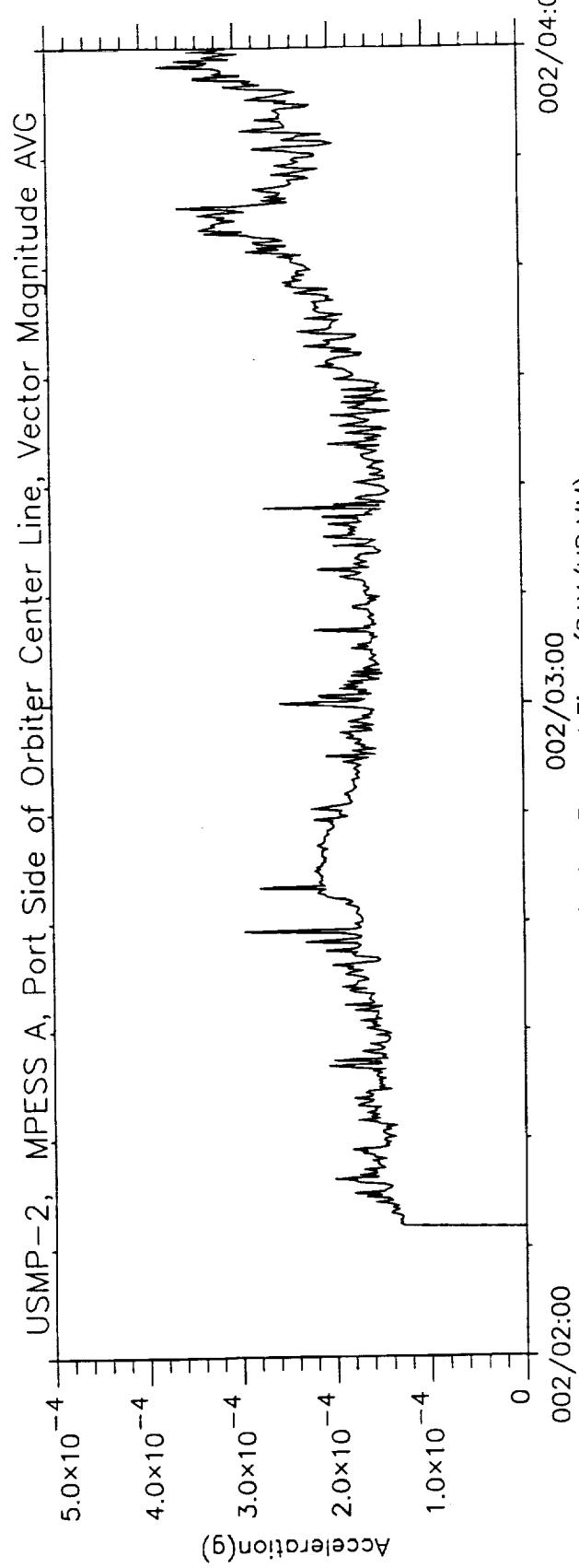


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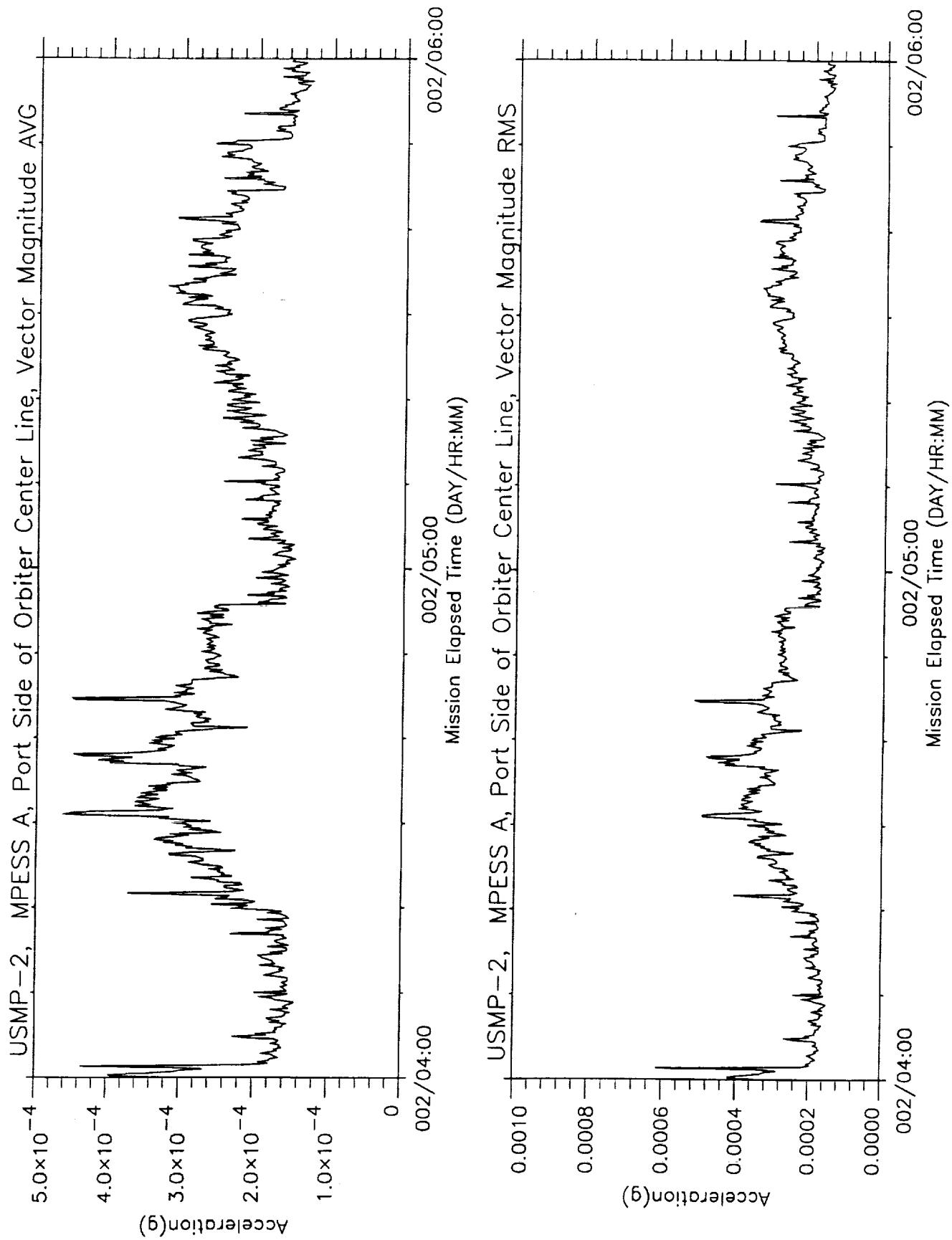
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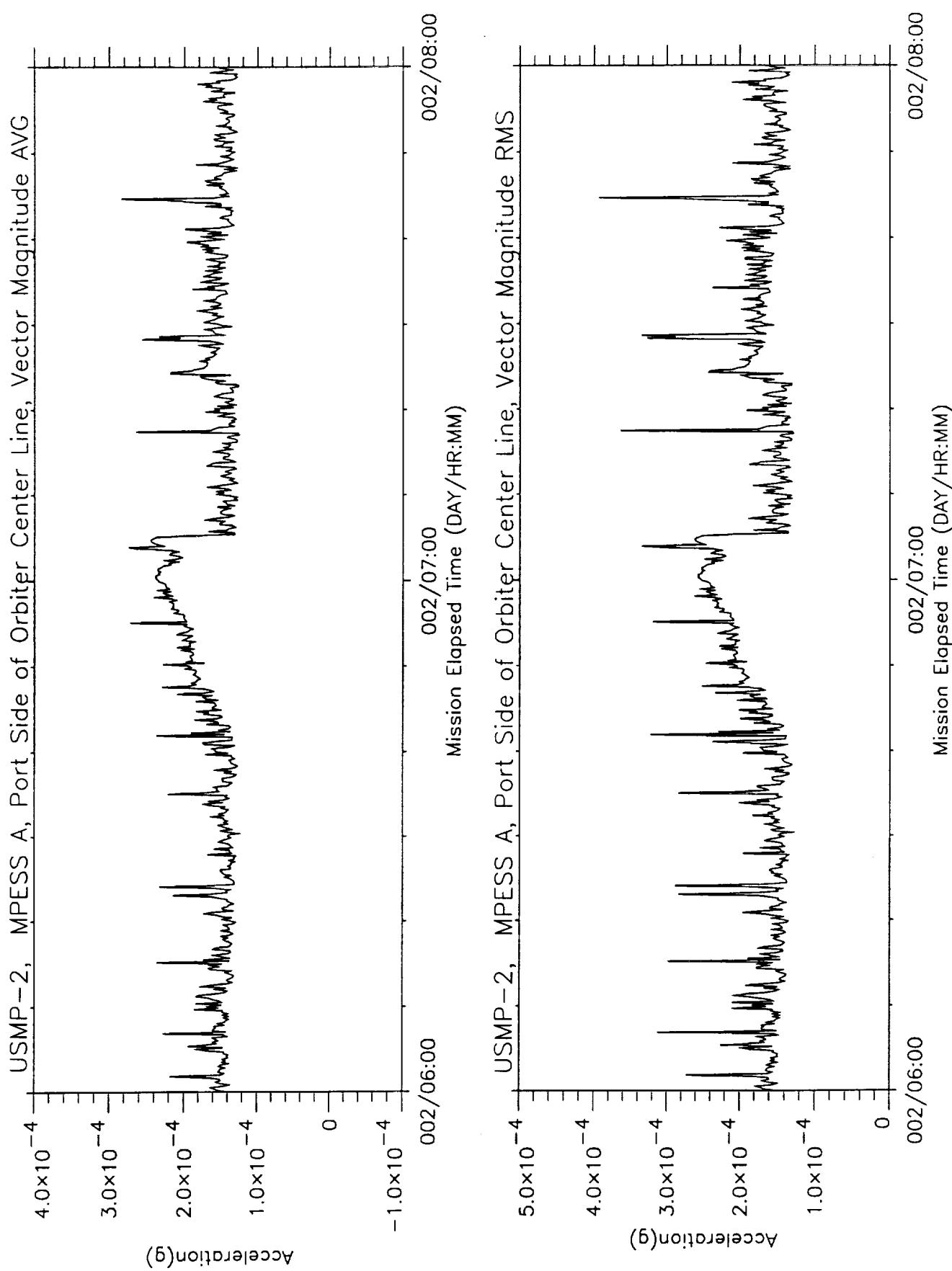
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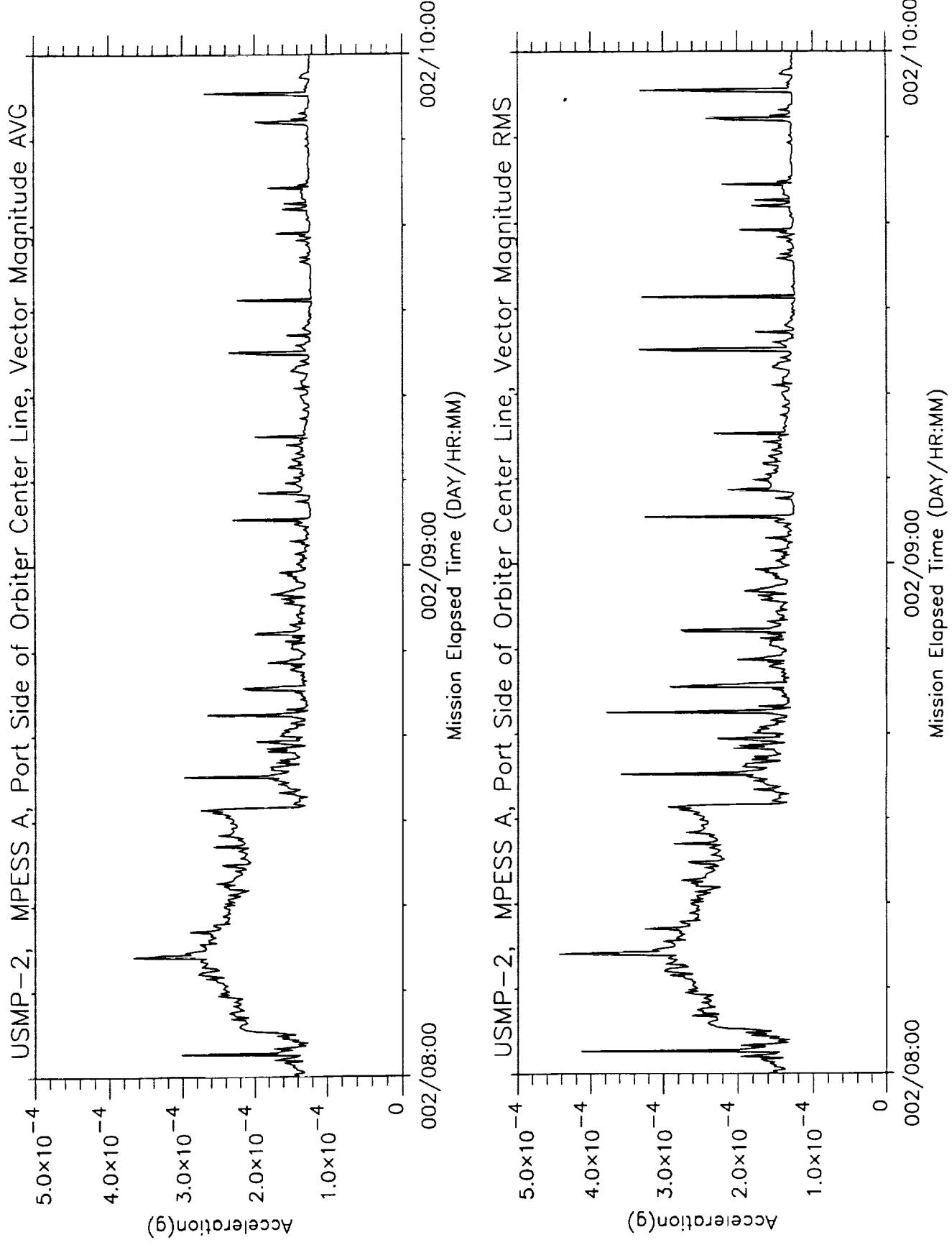
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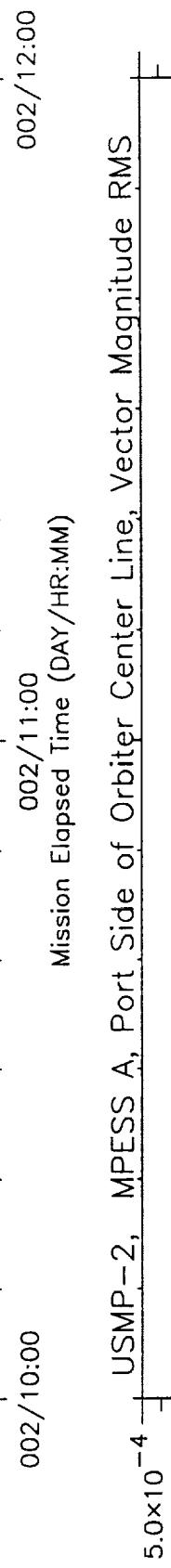
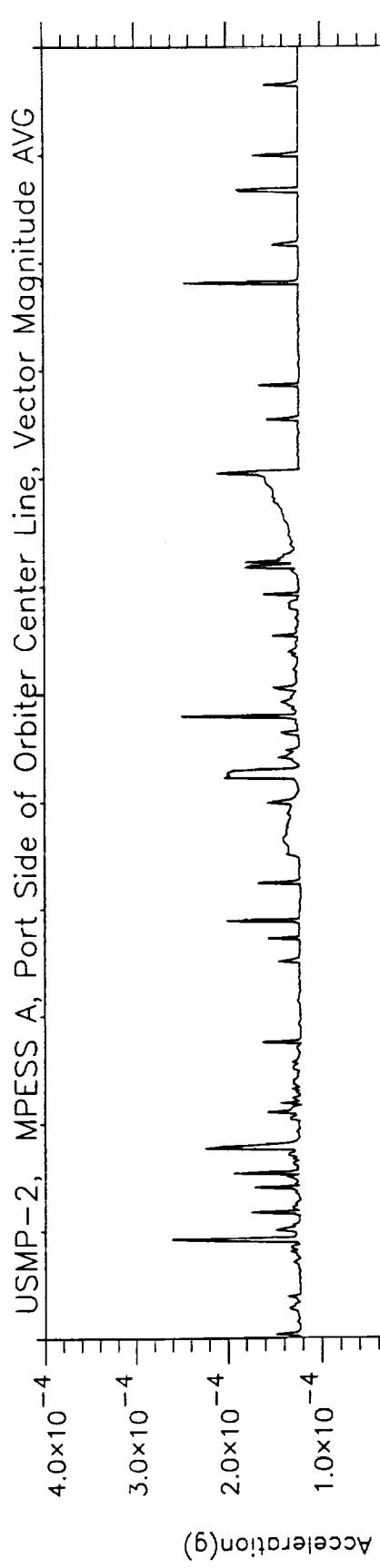
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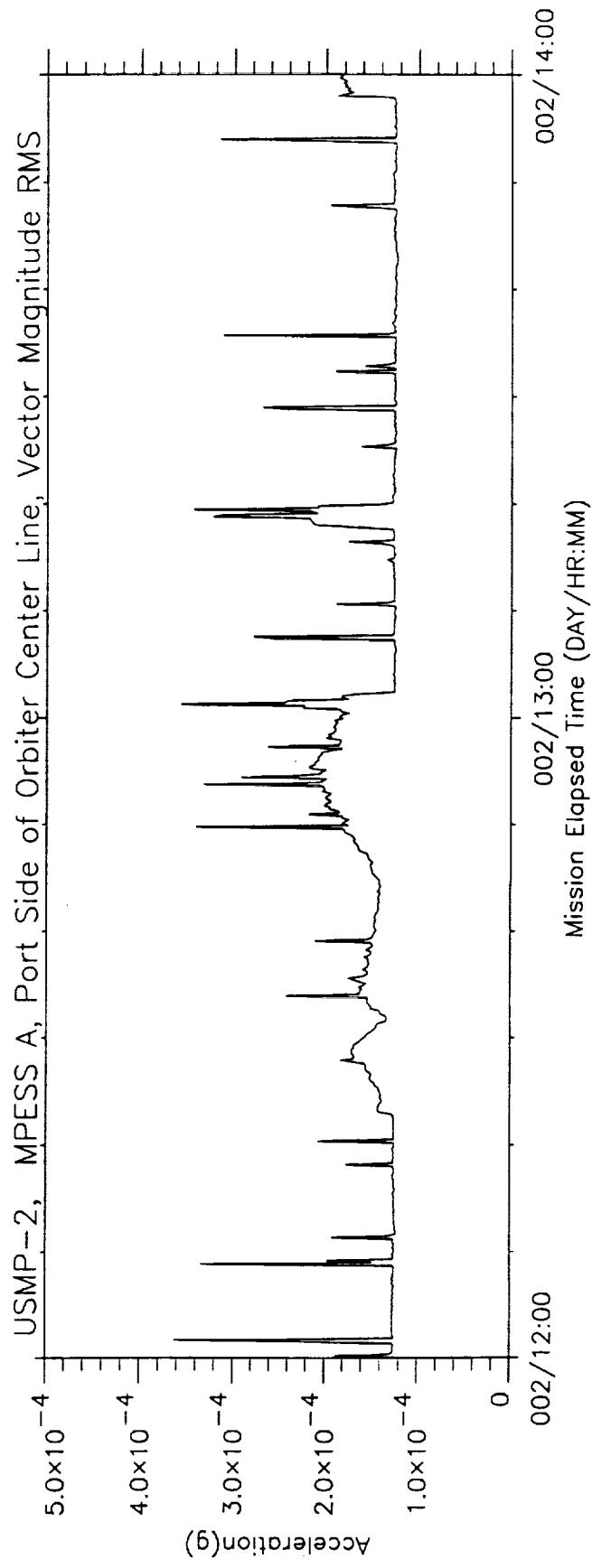
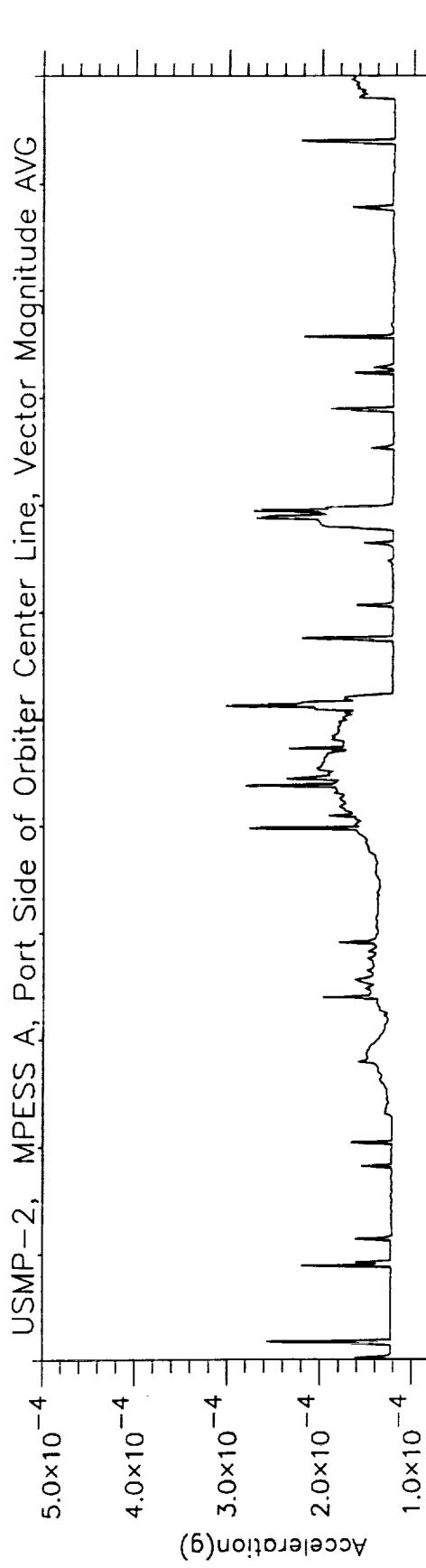
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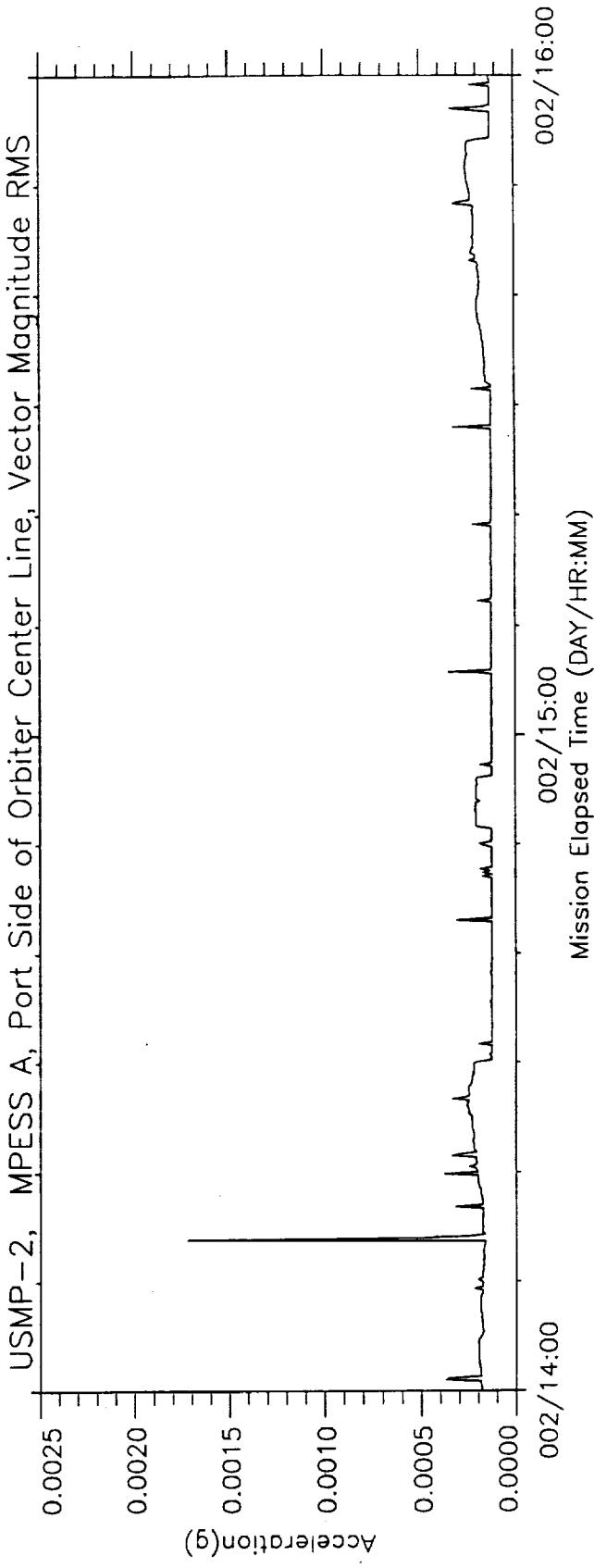
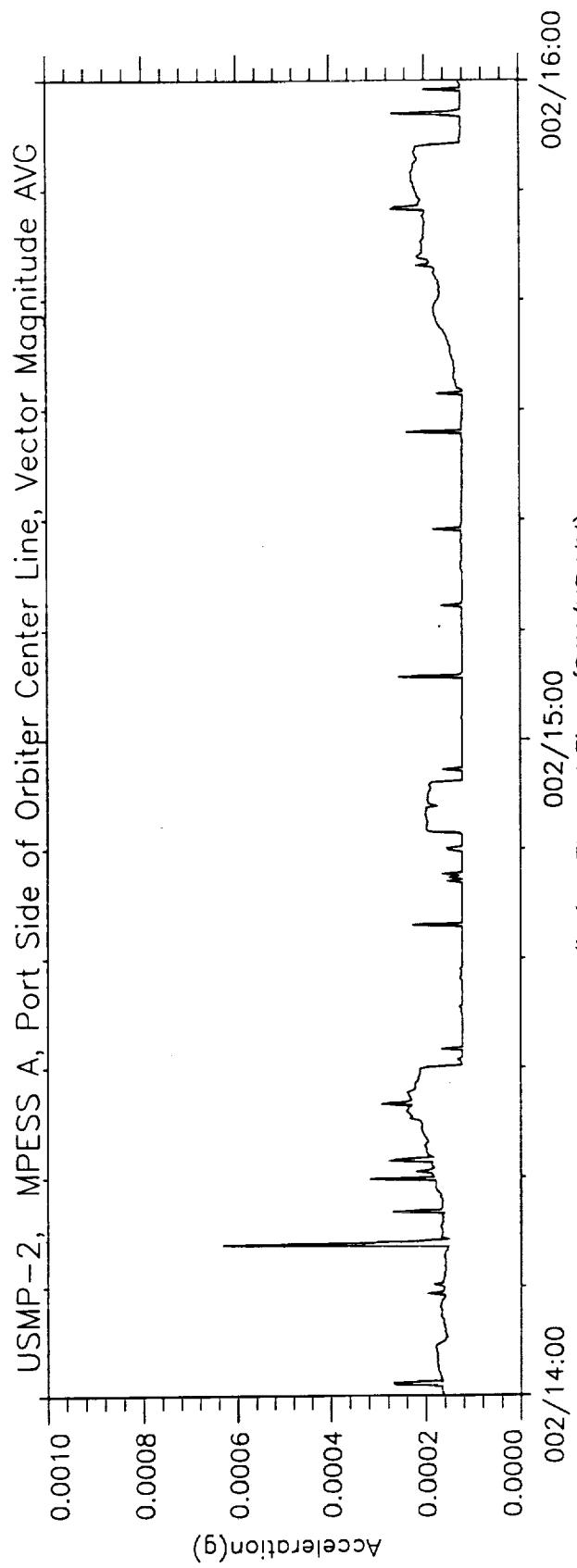
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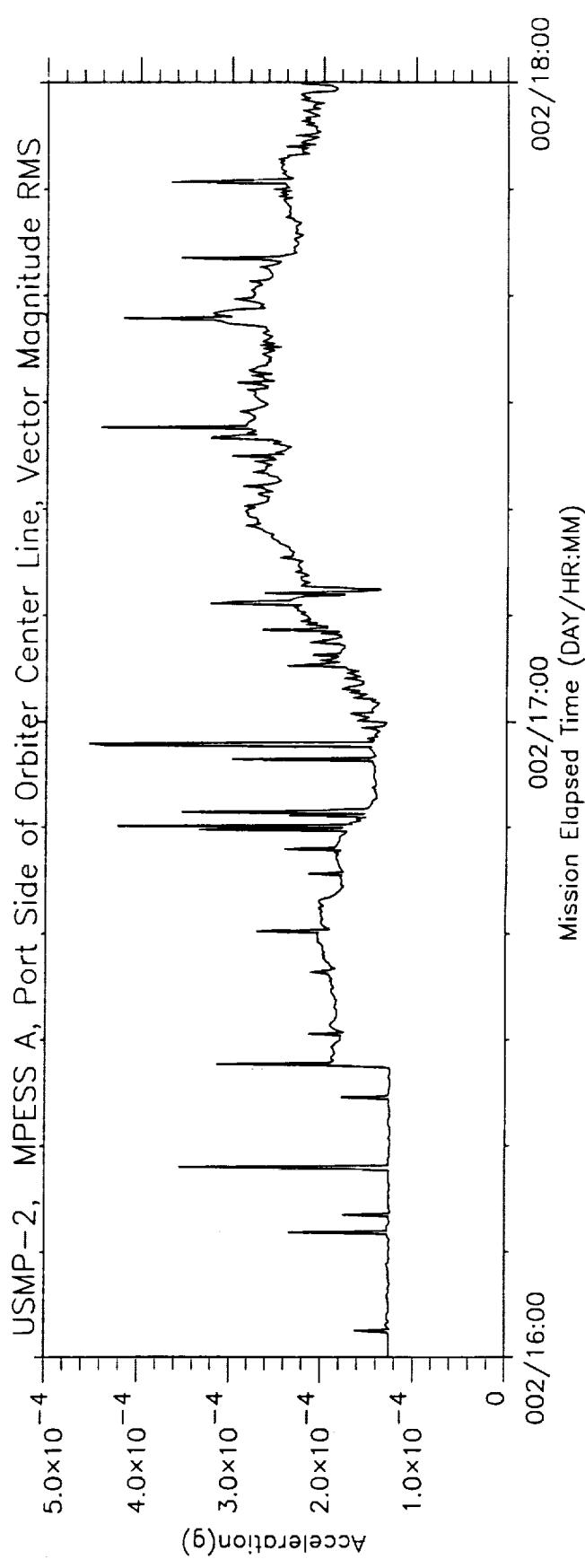
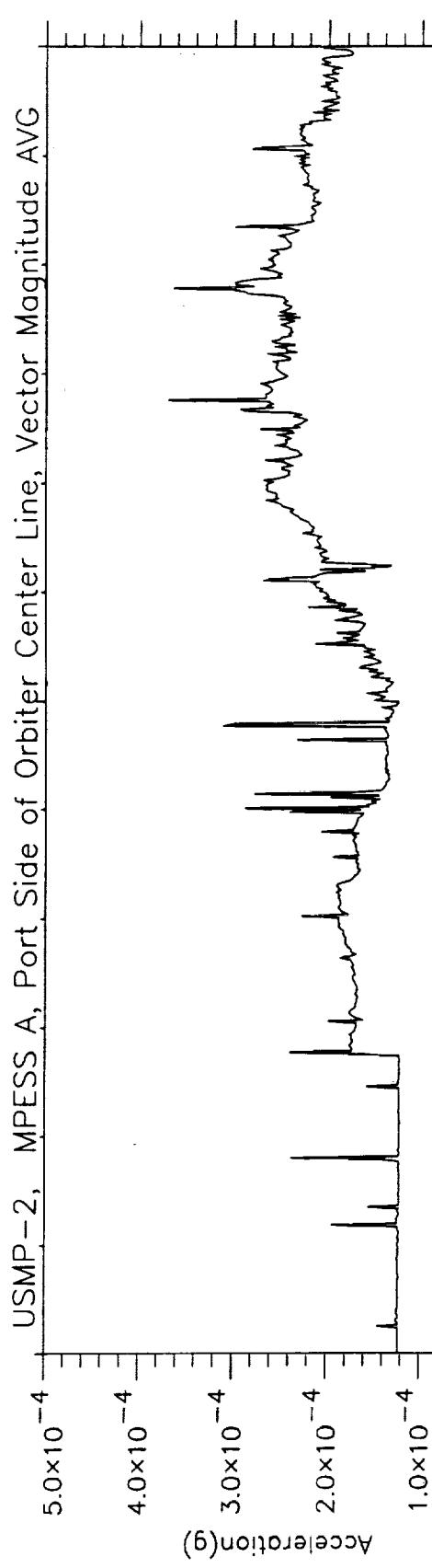
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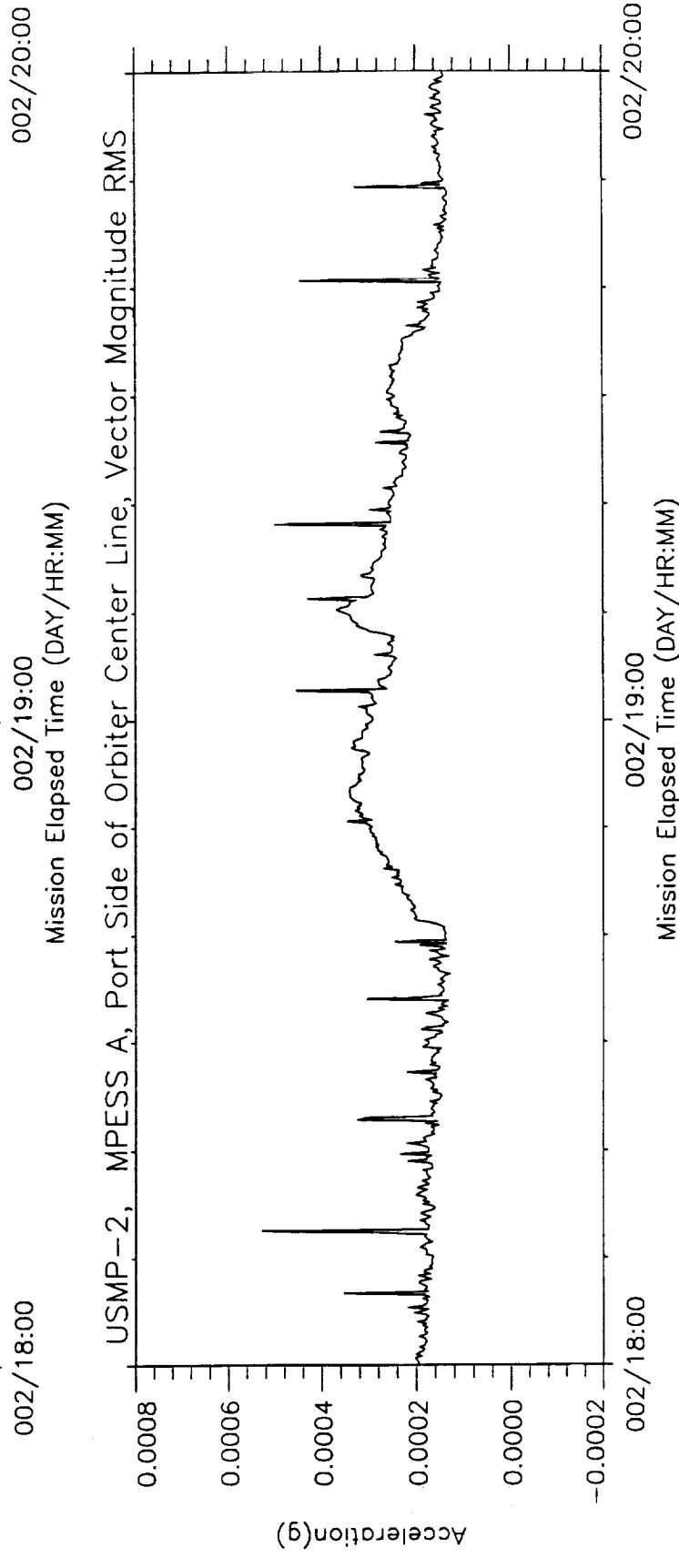
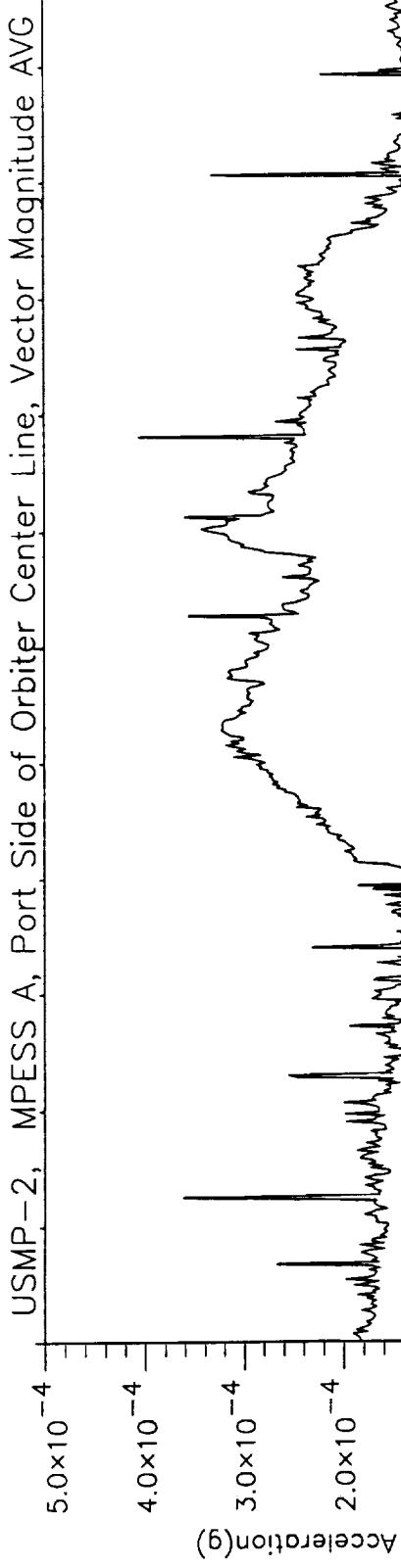
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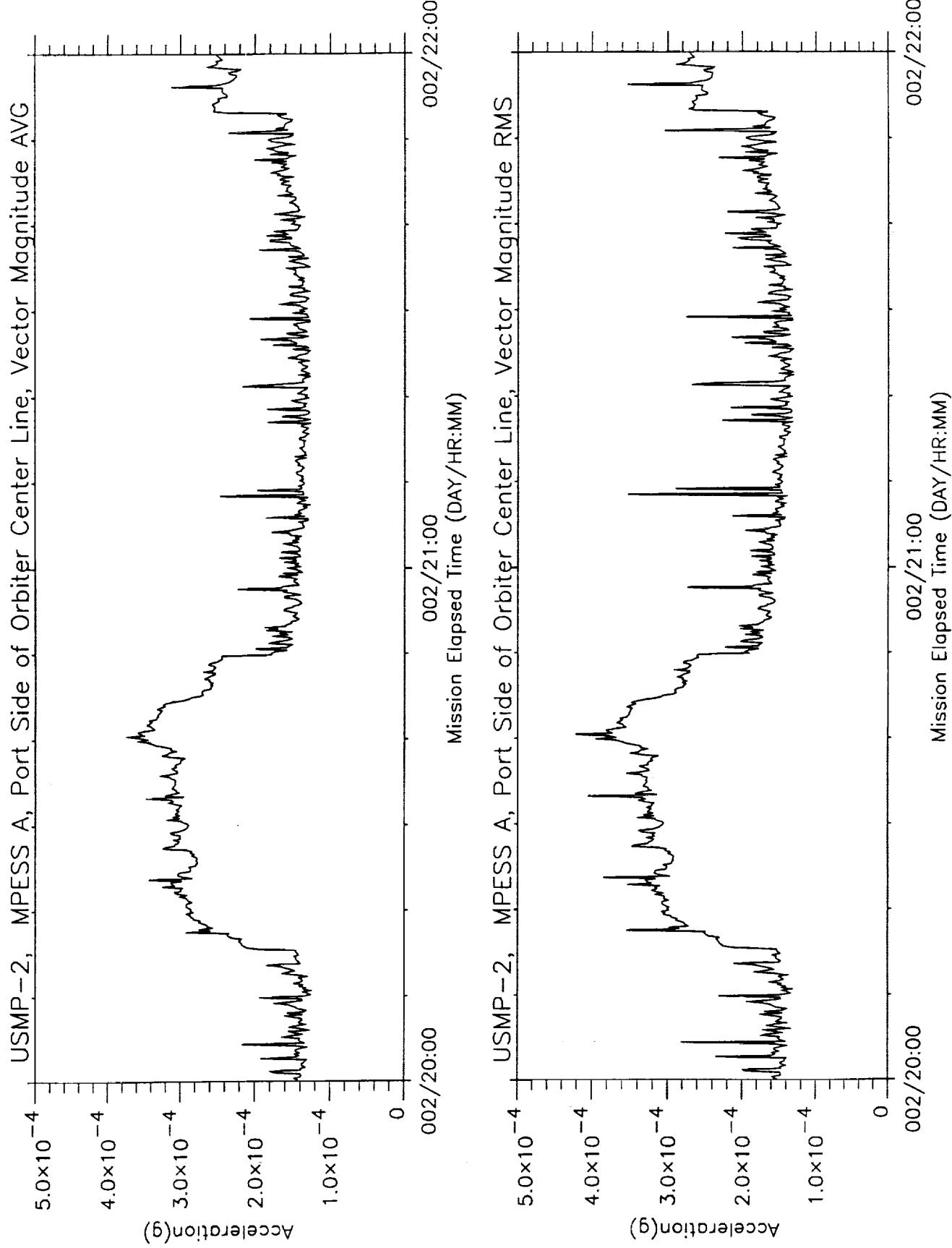
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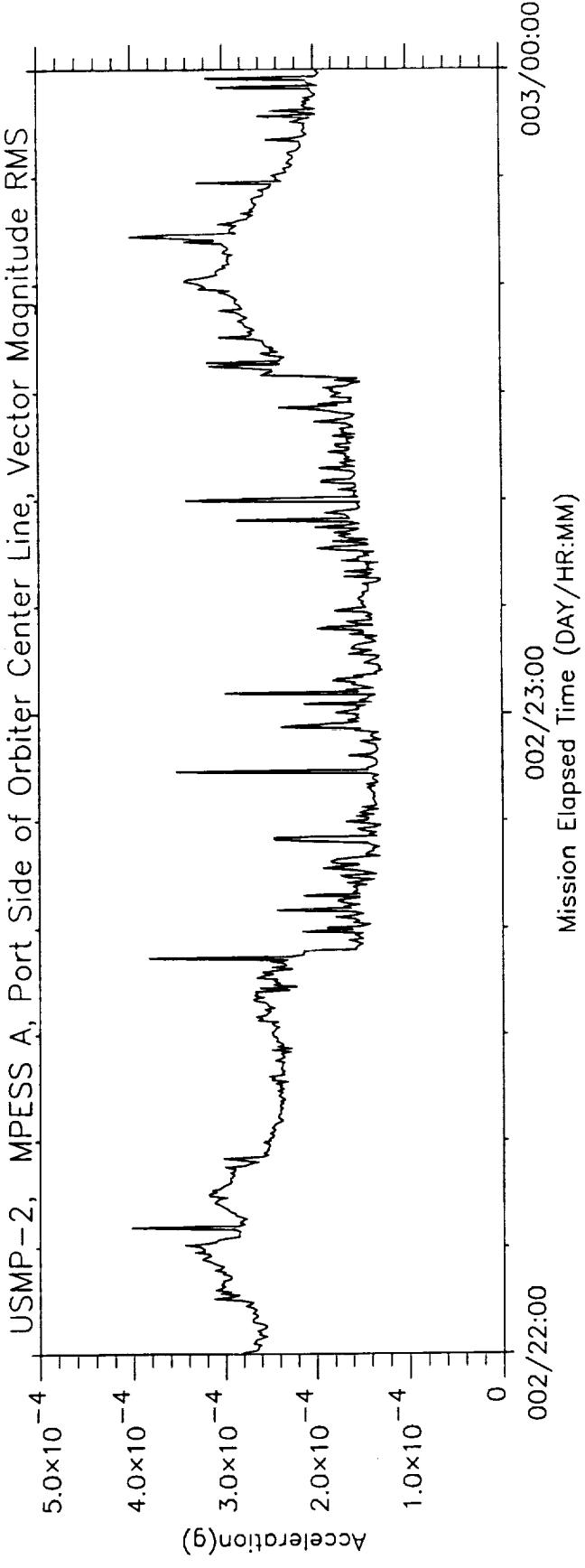
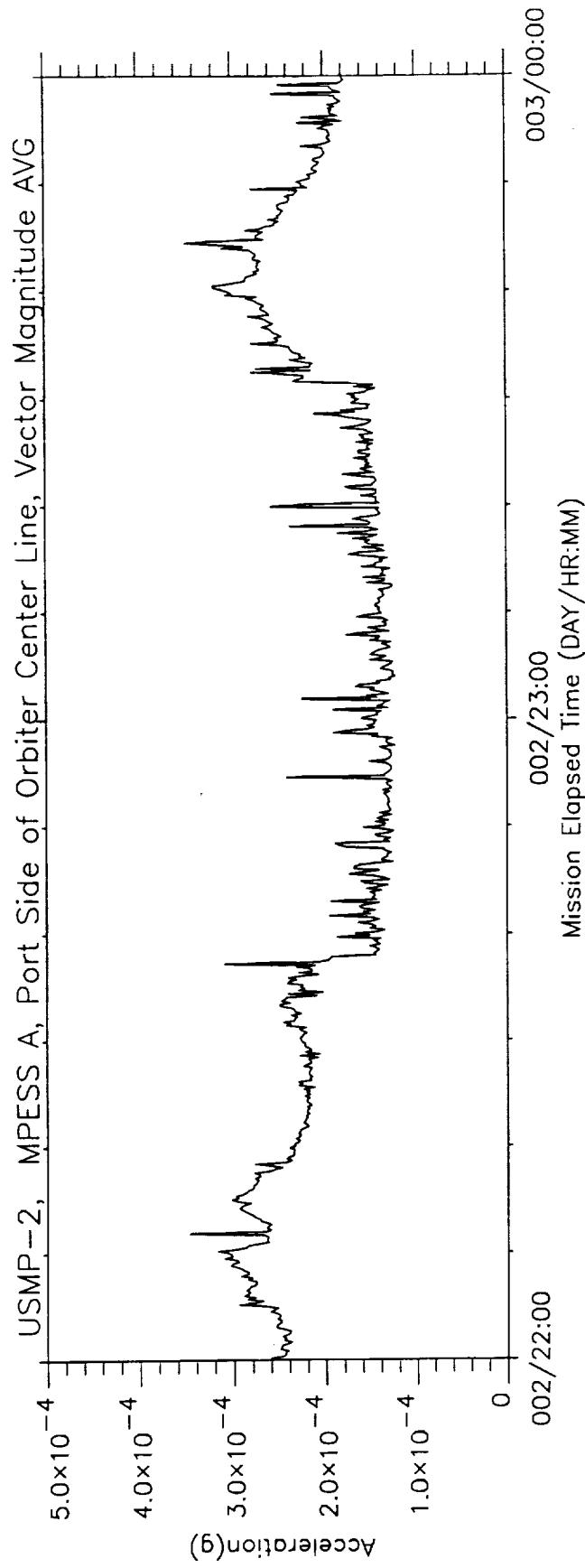
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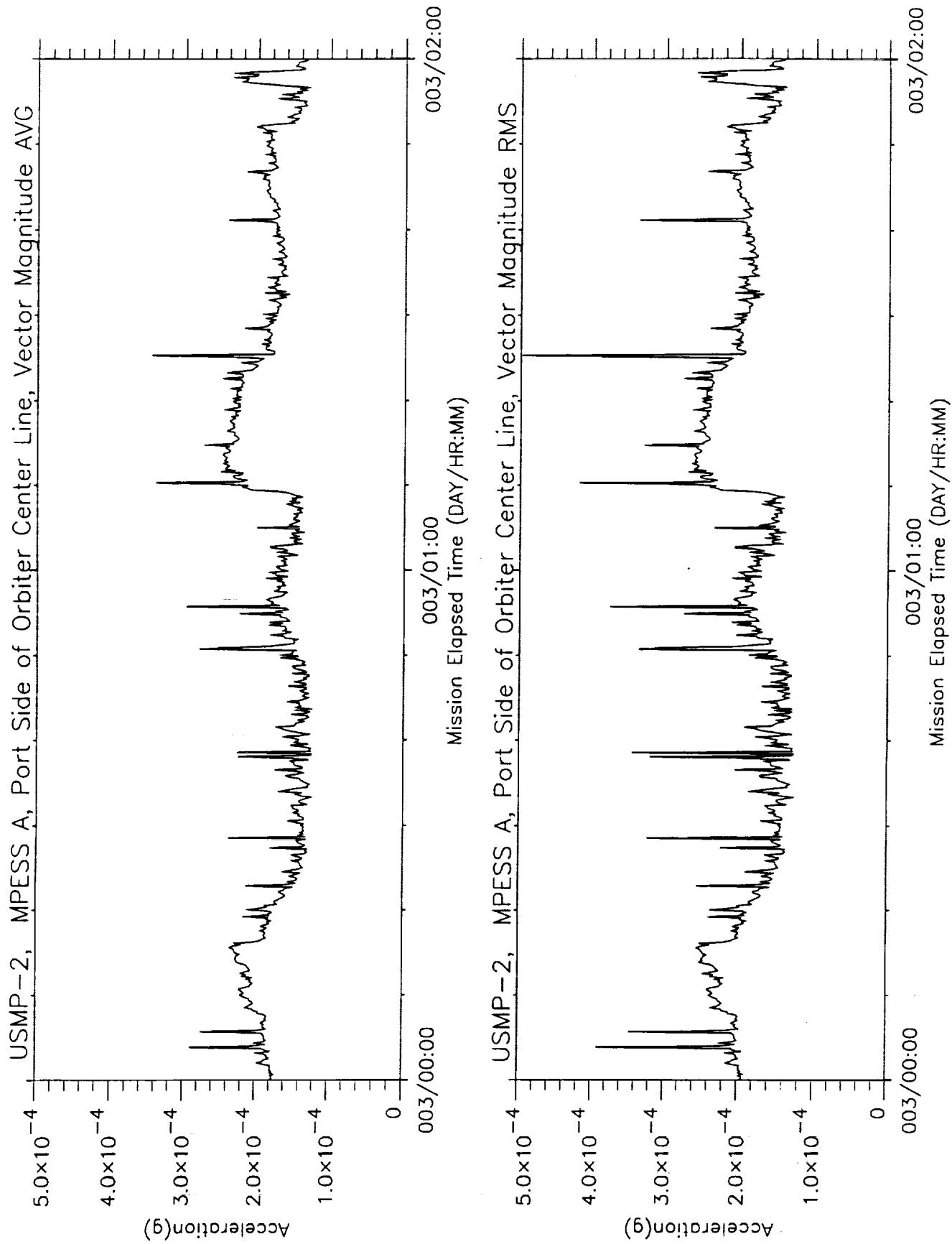
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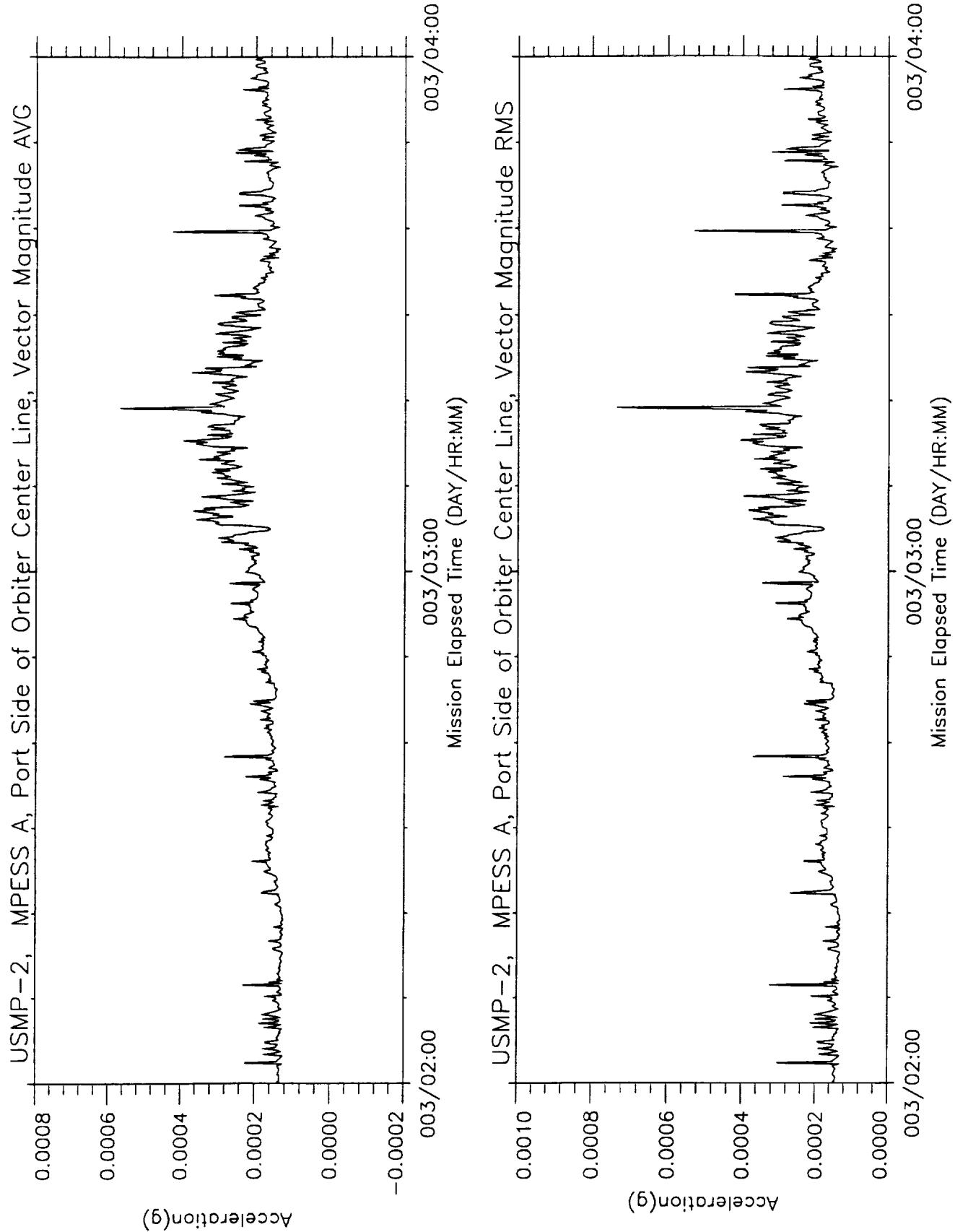
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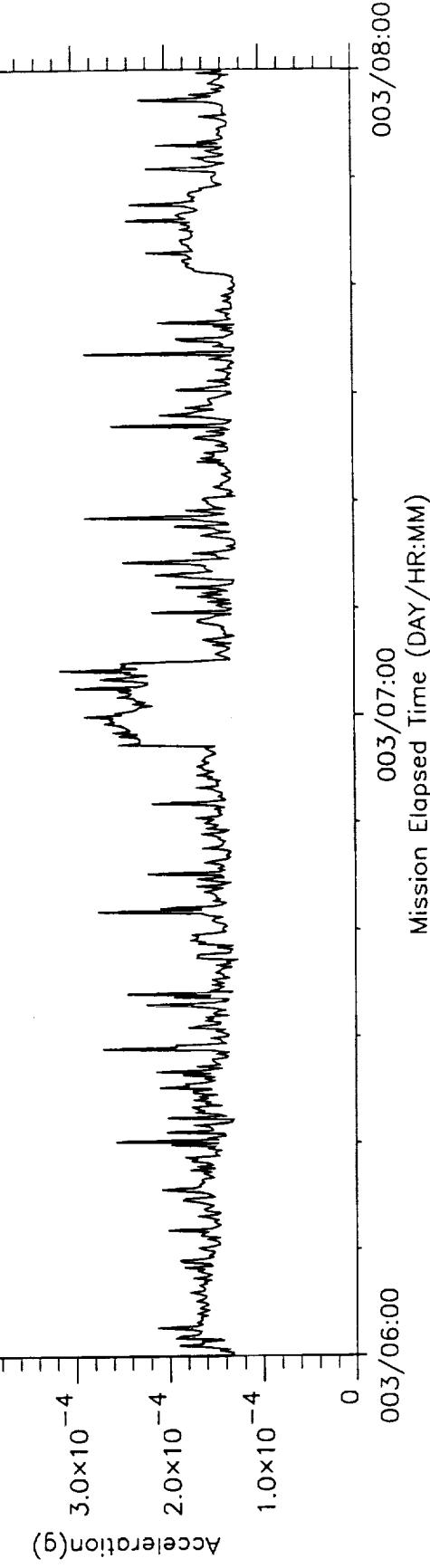
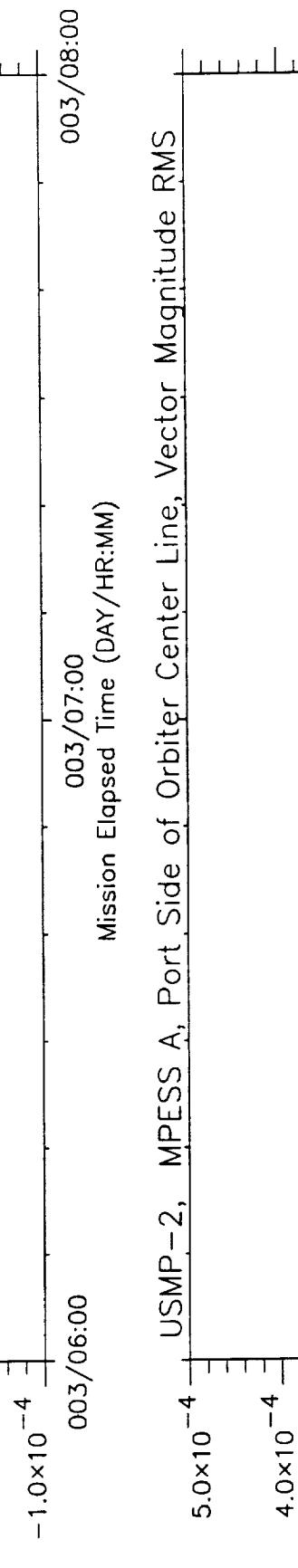
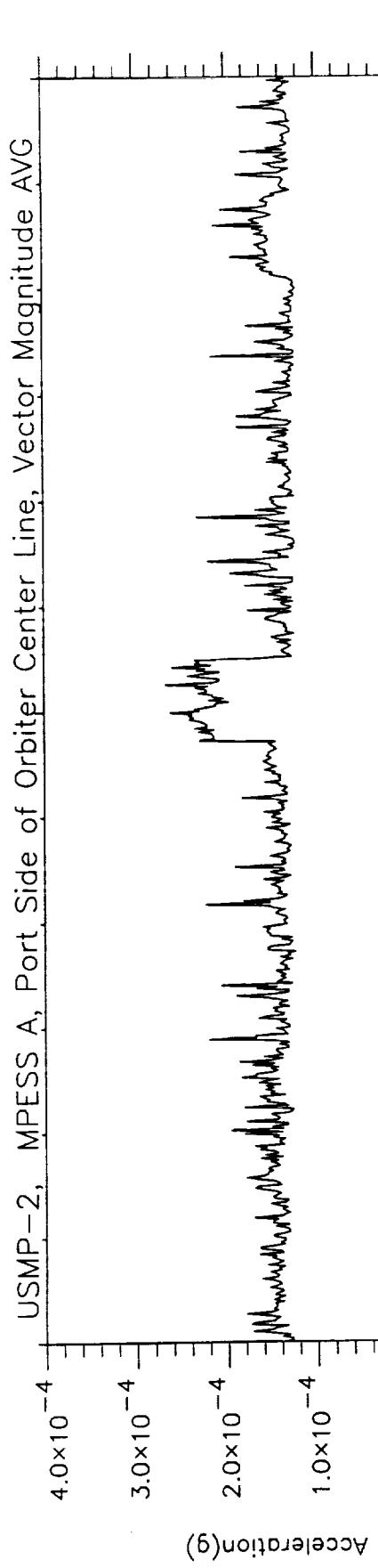


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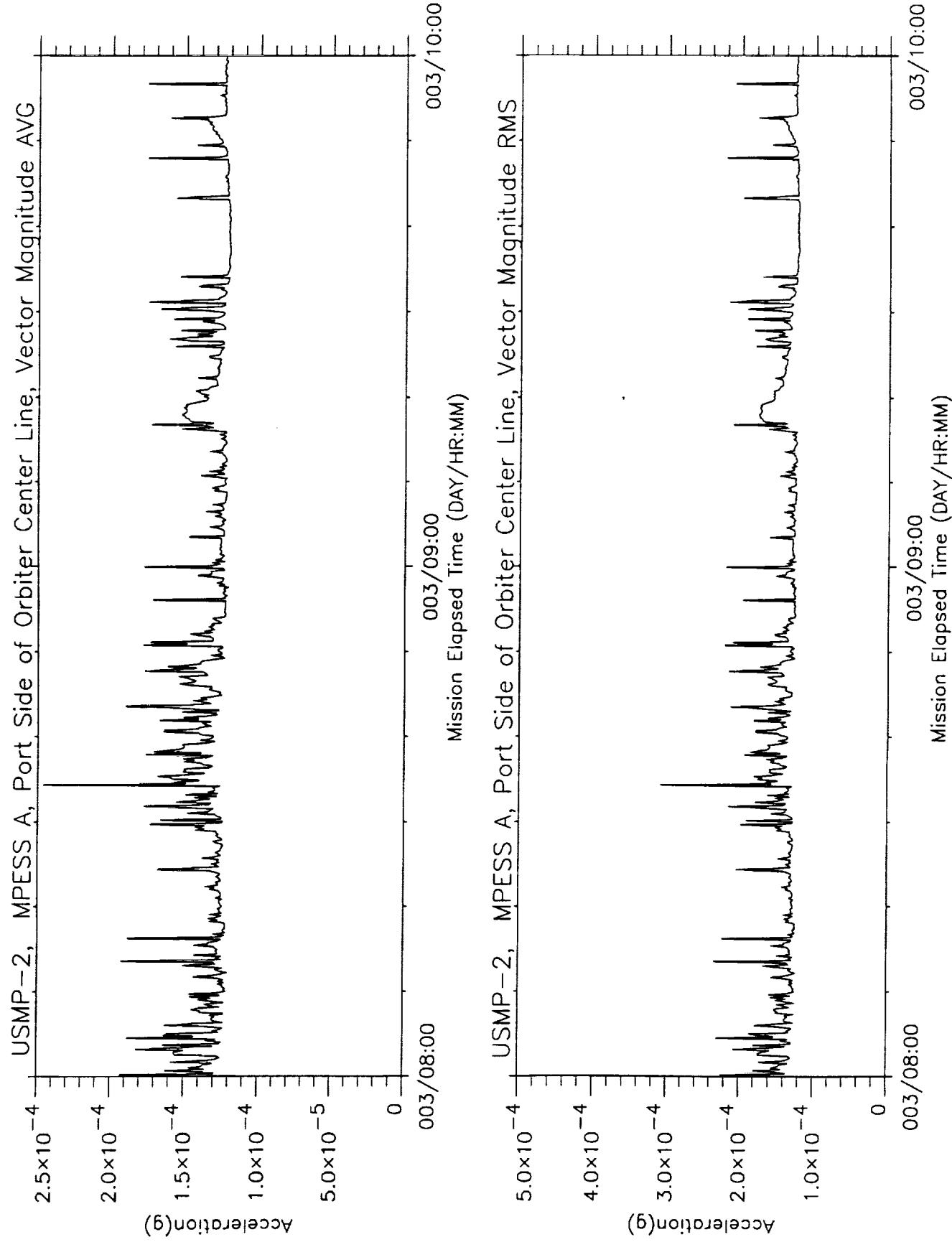
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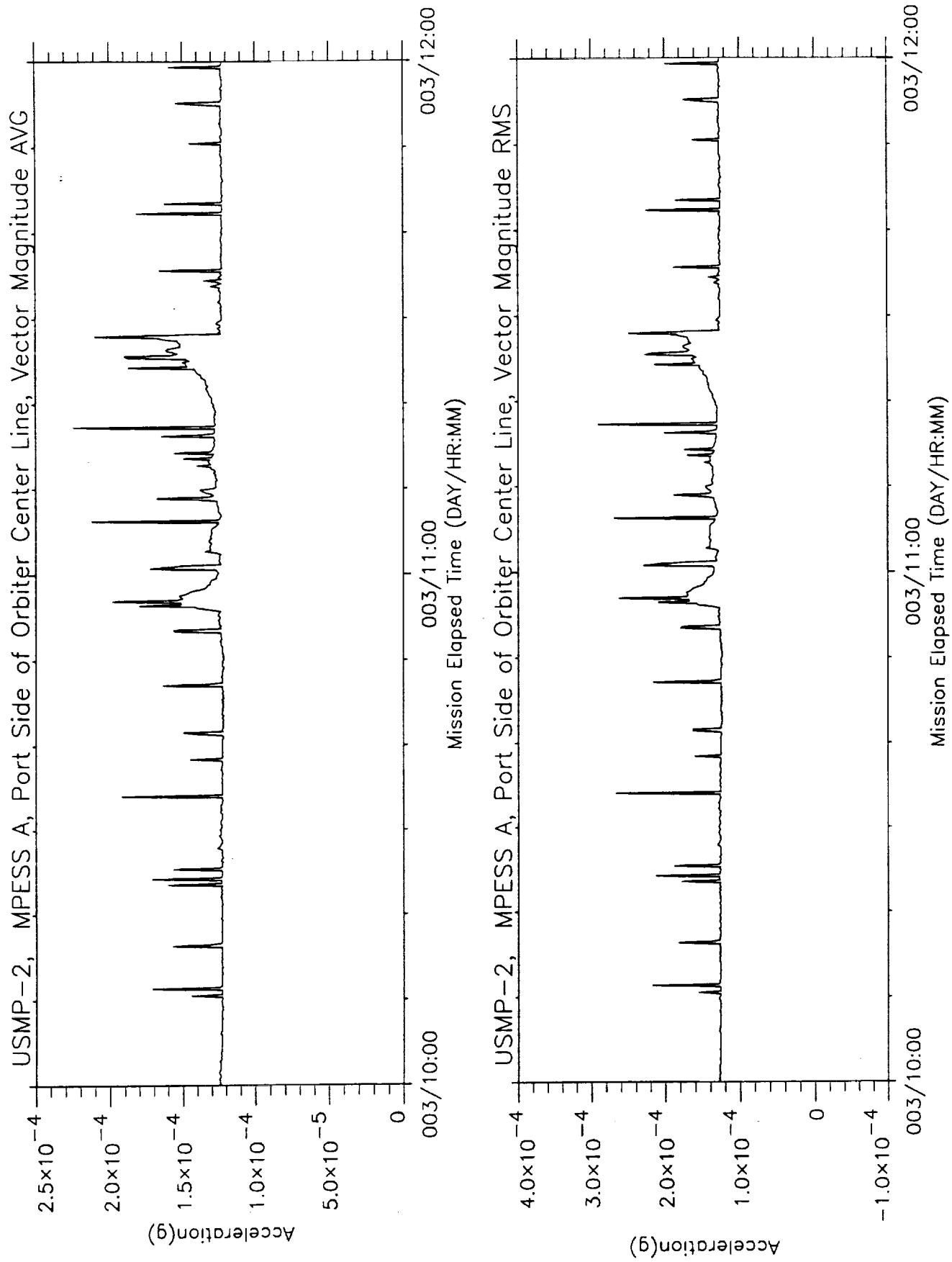
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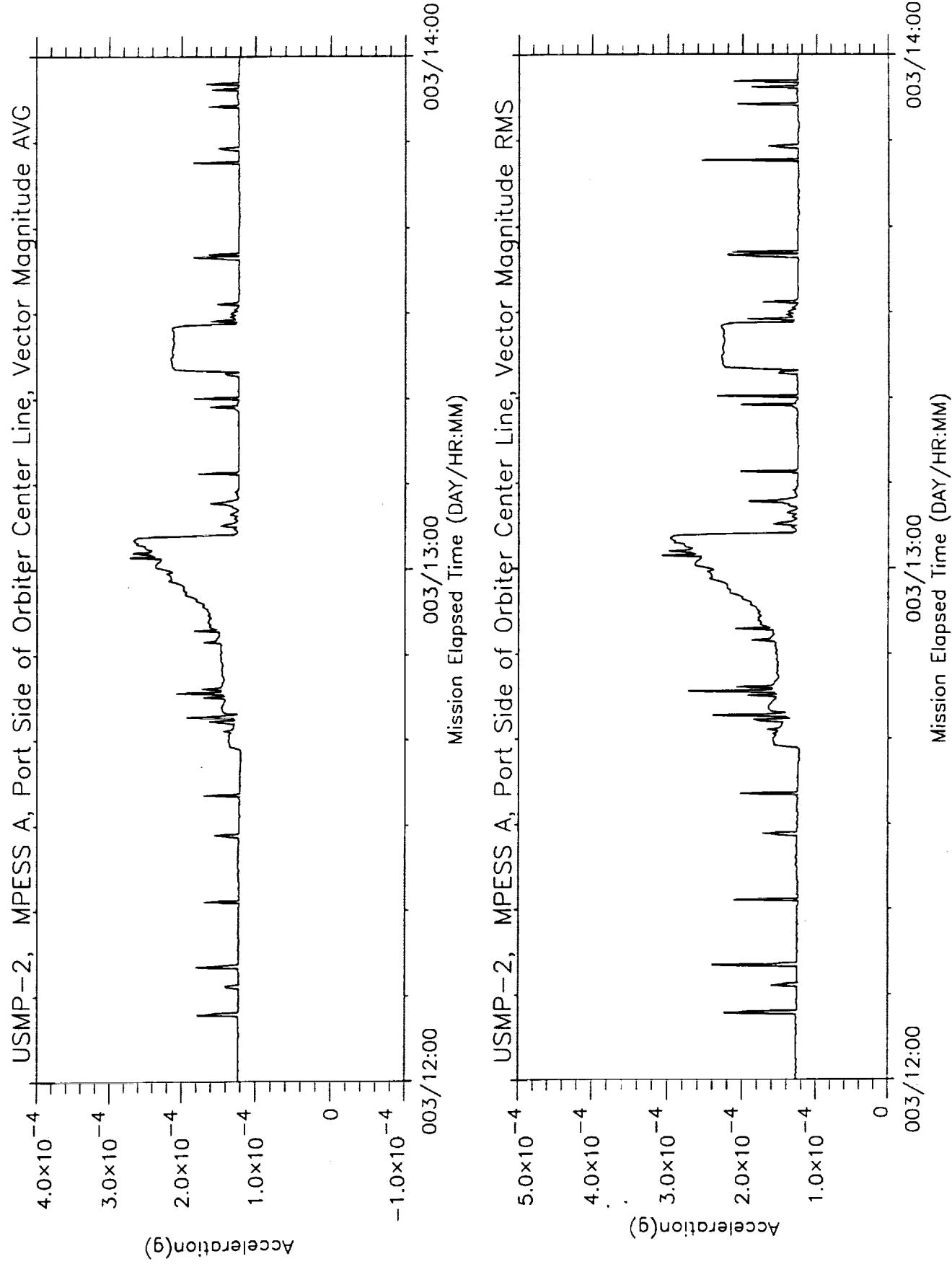
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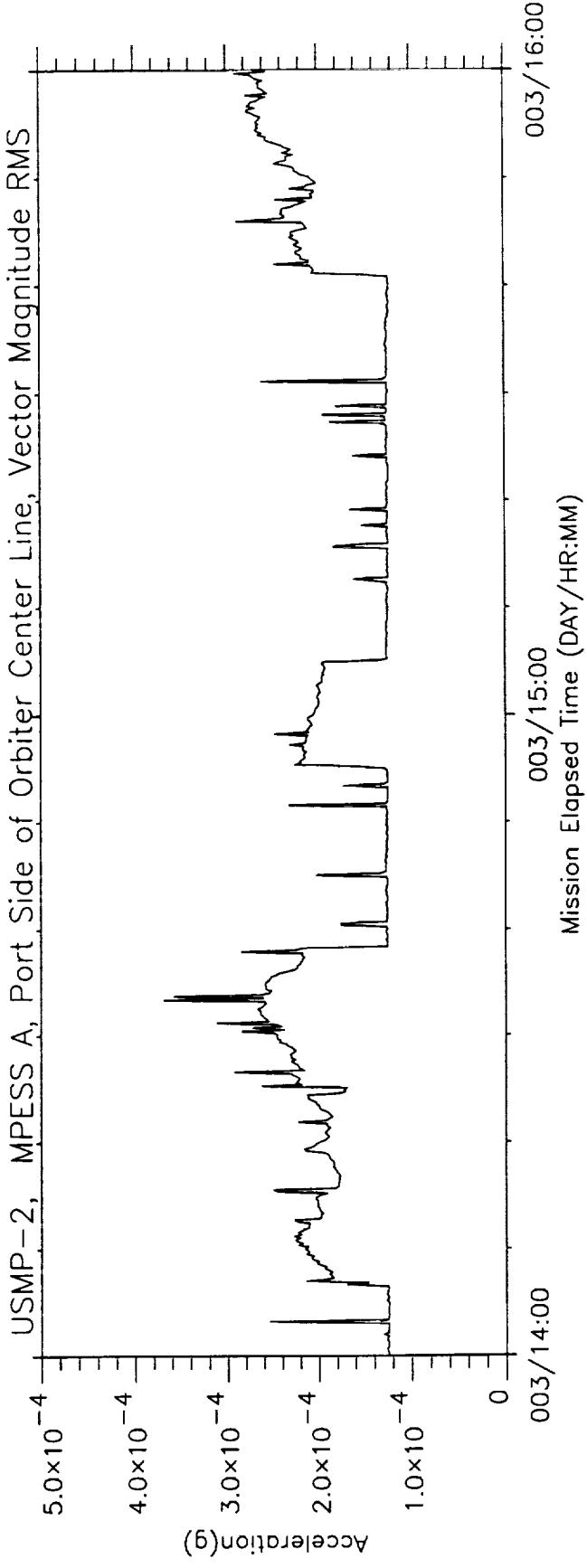
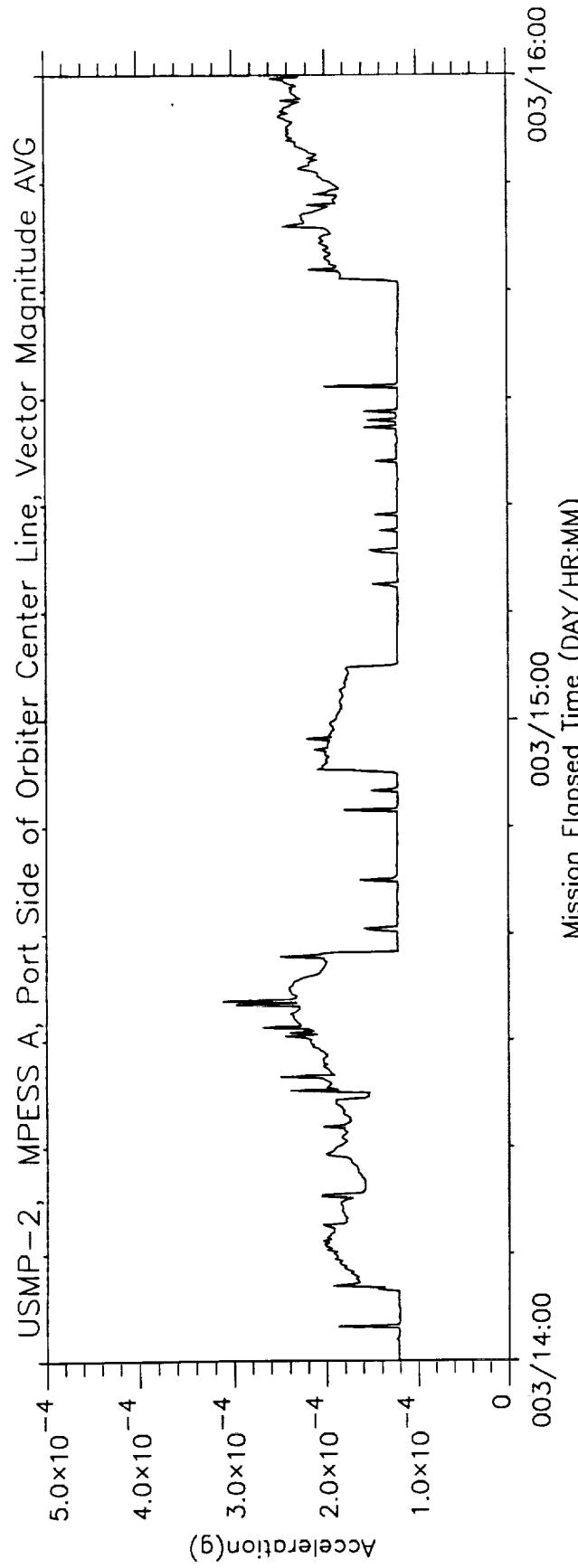
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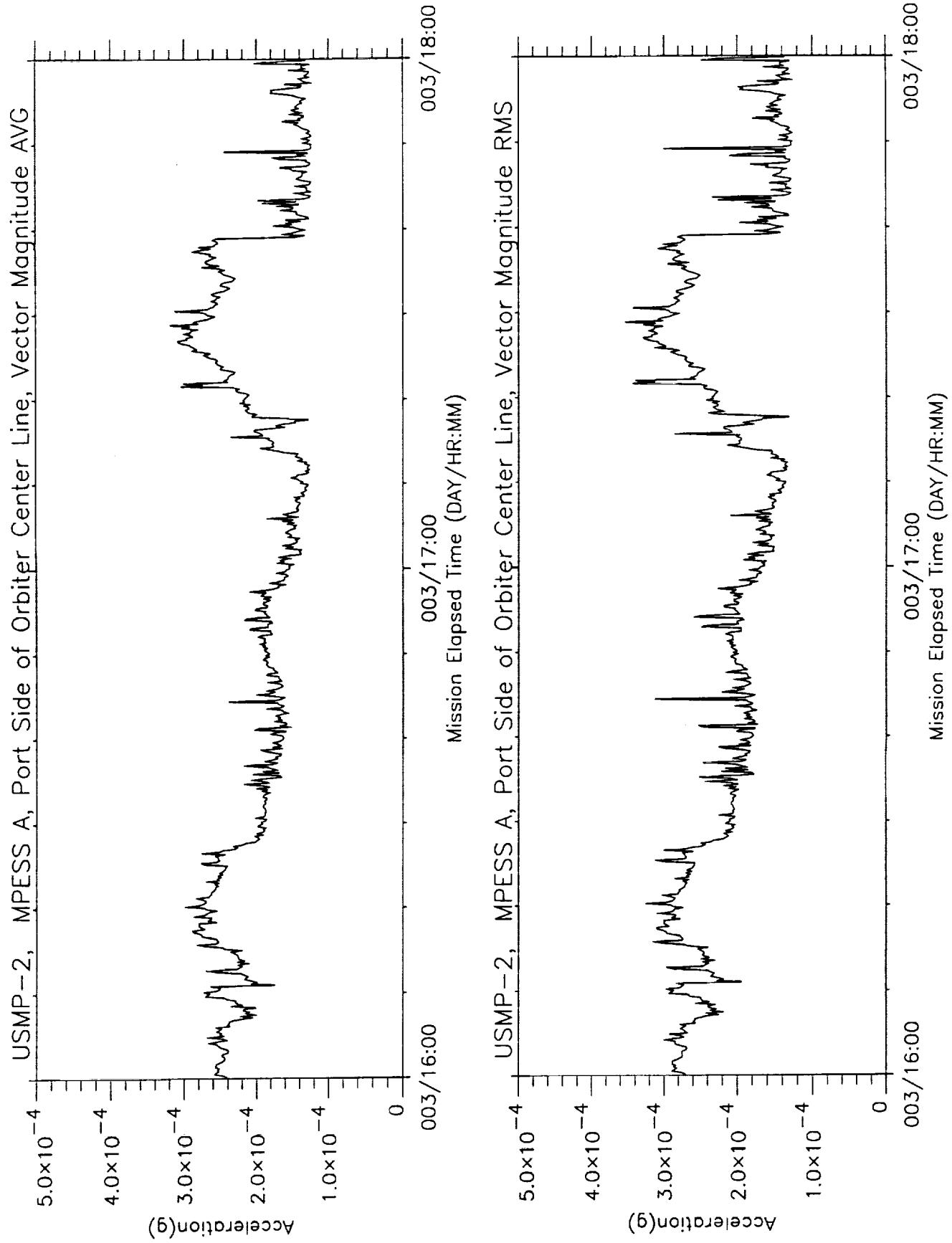
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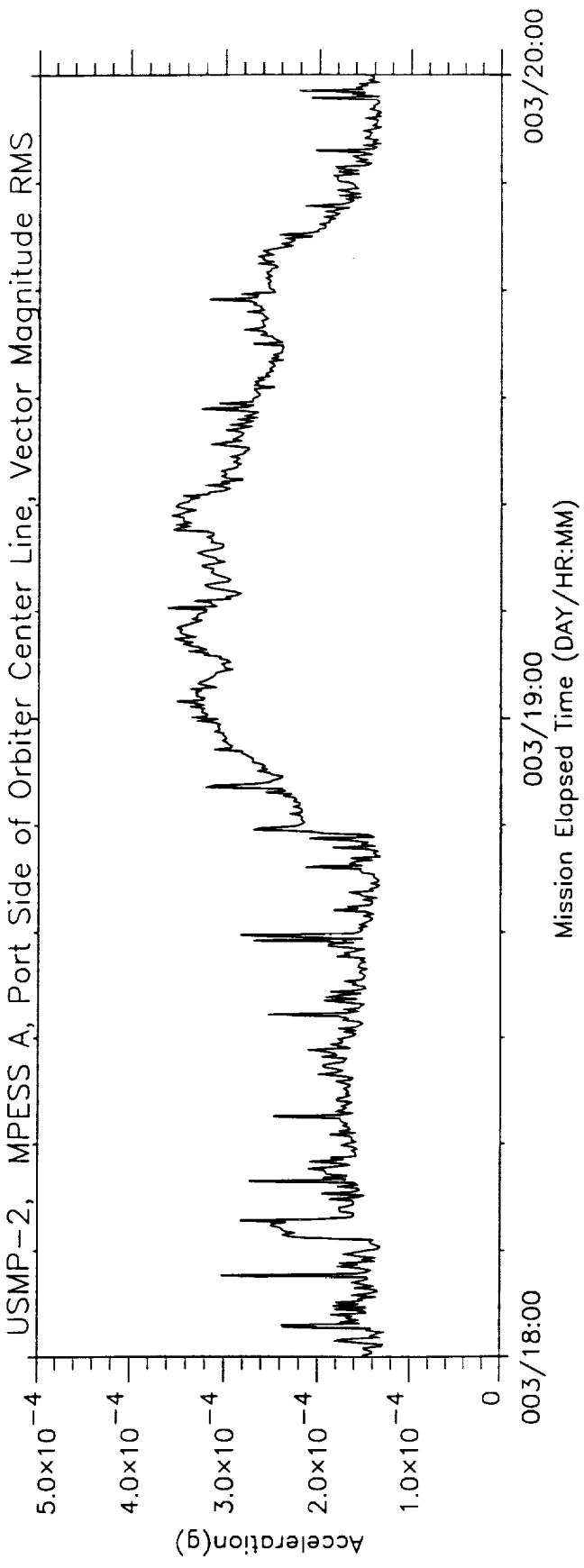
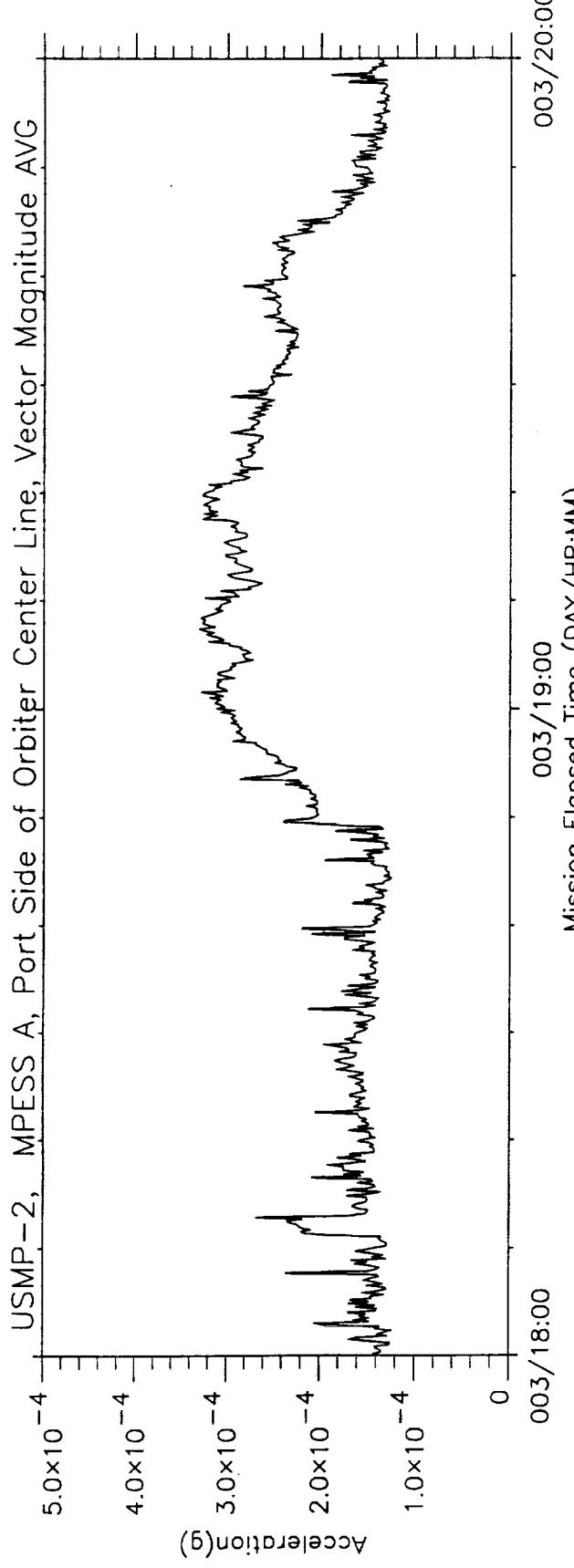
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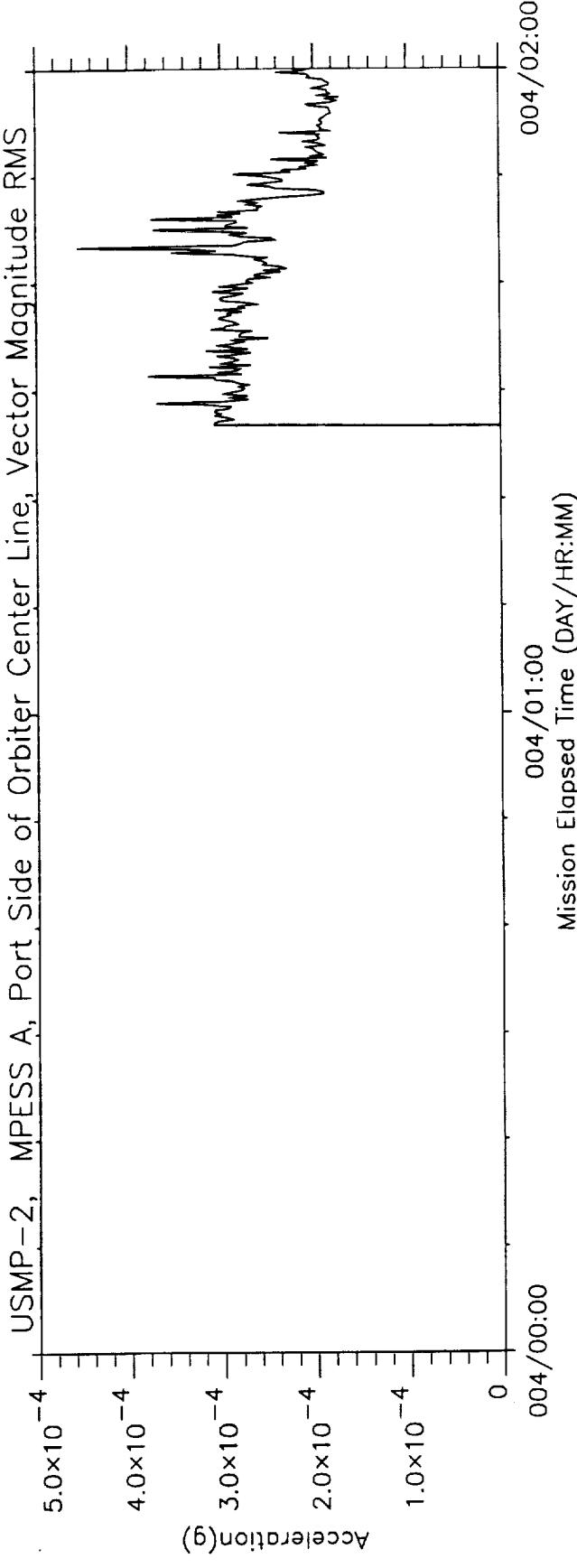
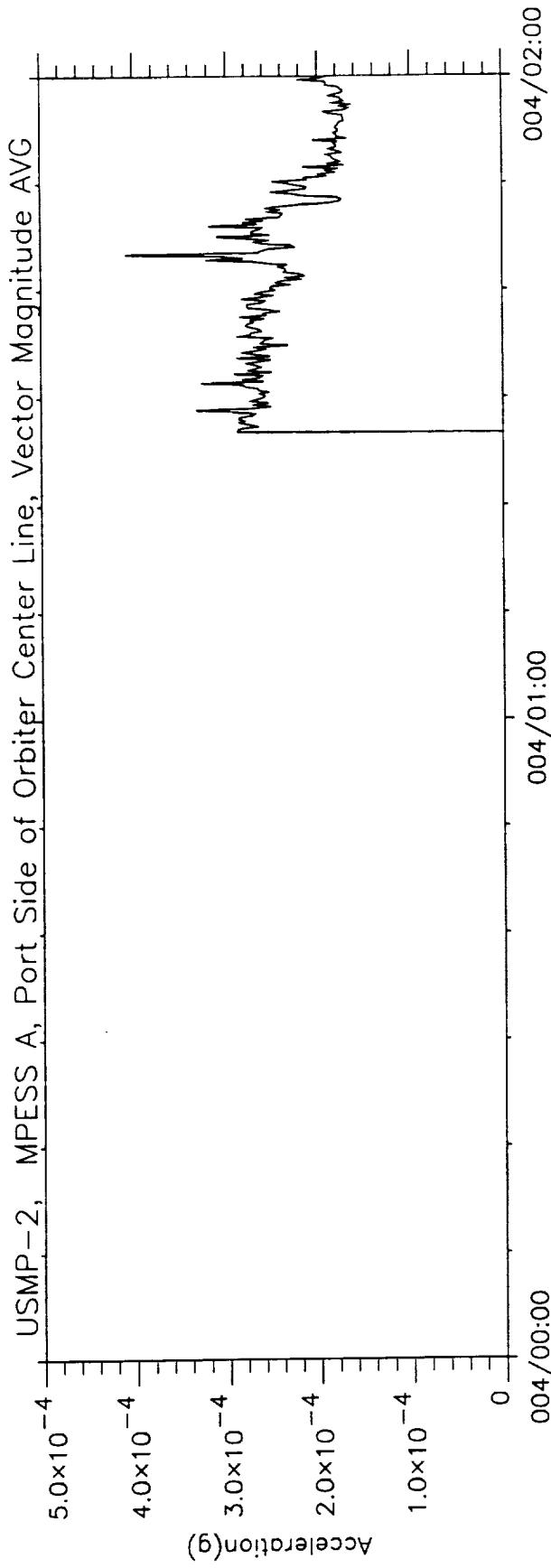


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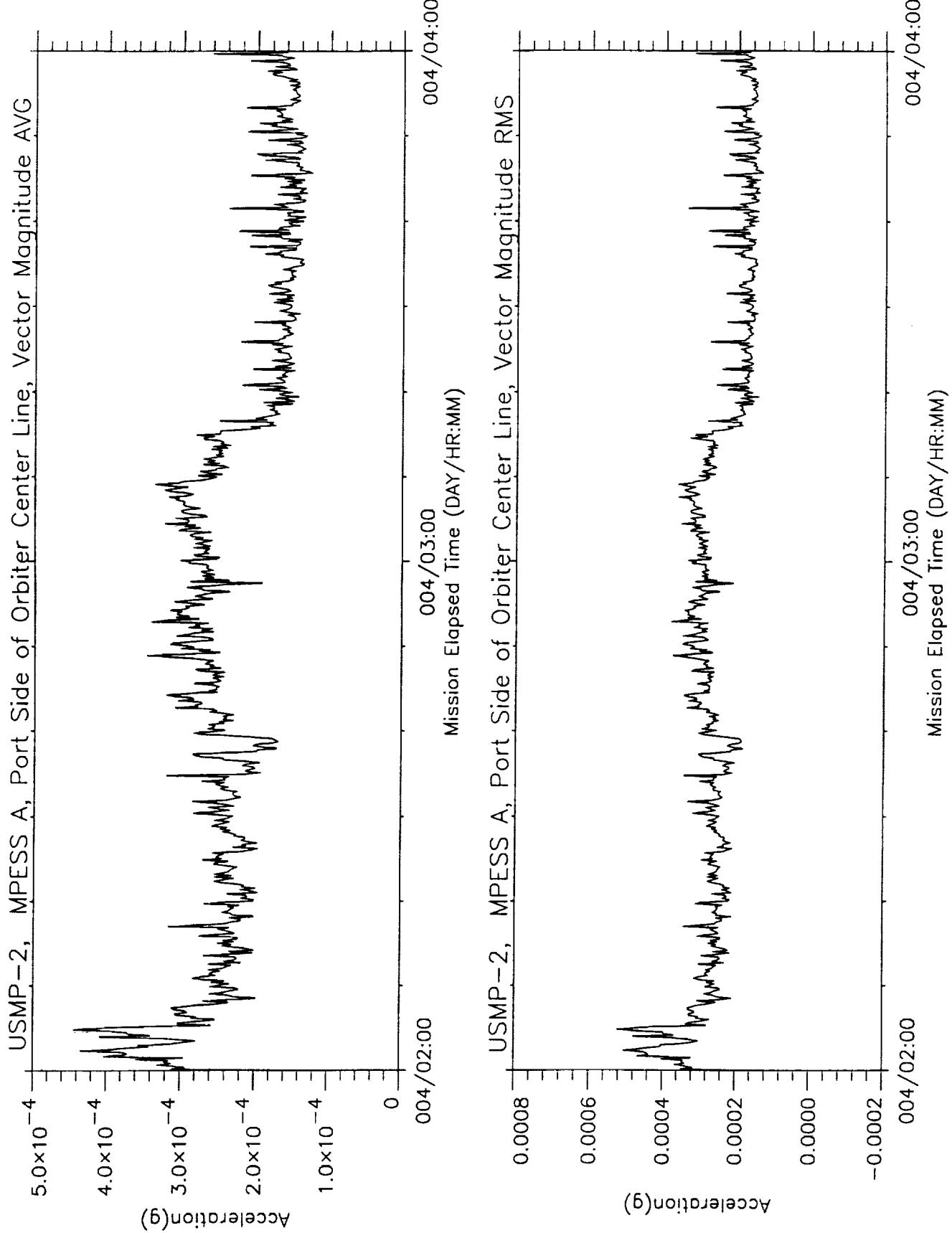
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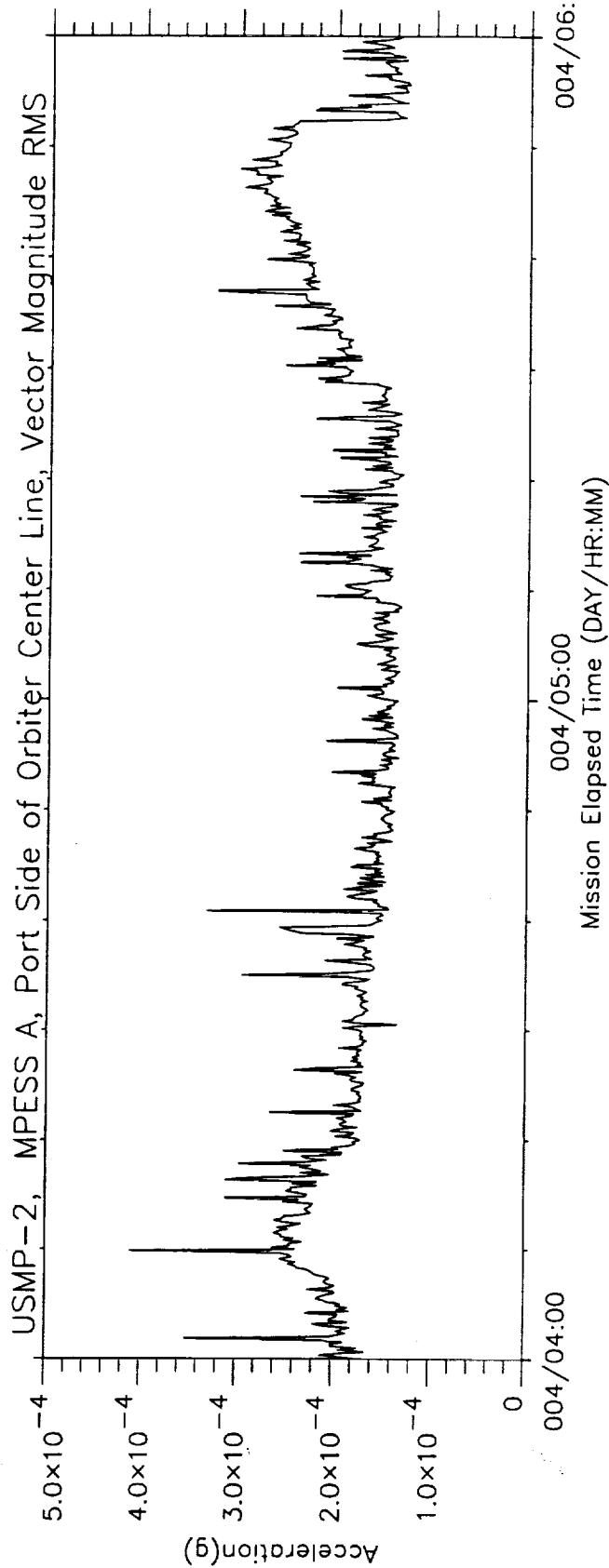
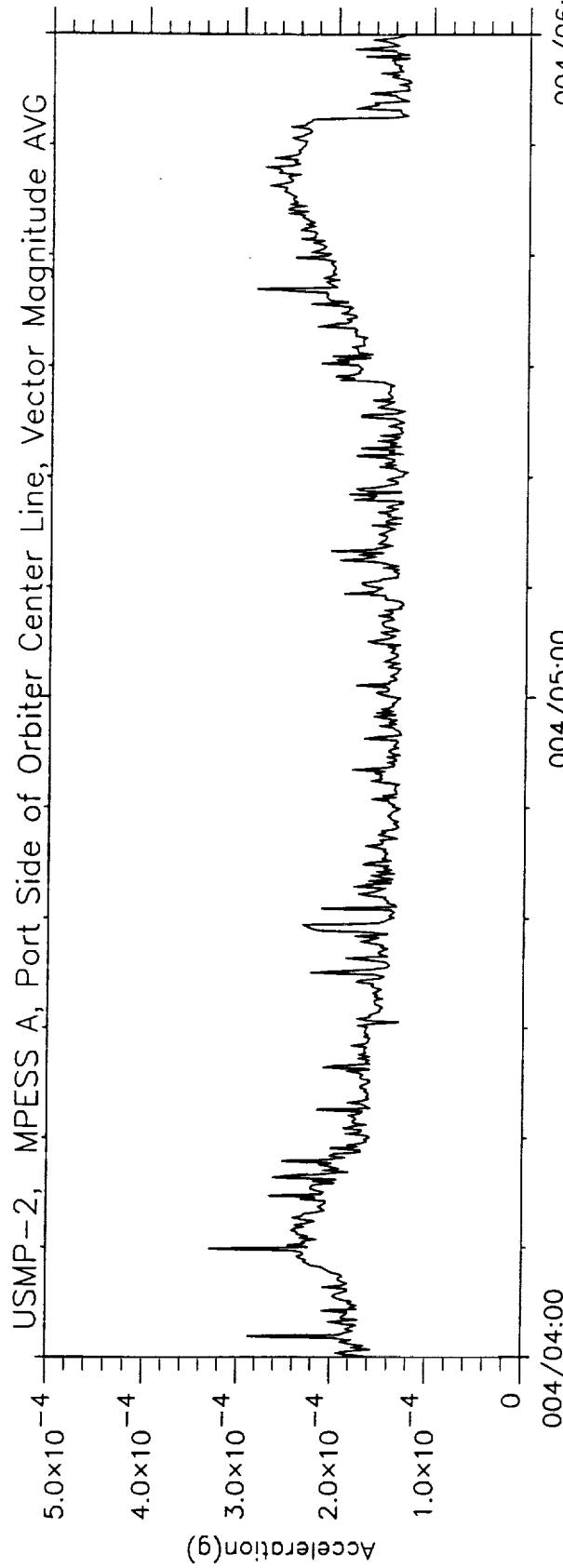
SUMMARY REPORT OF MISSION ACCELERATION MEASUREMENTS FOR STS-62



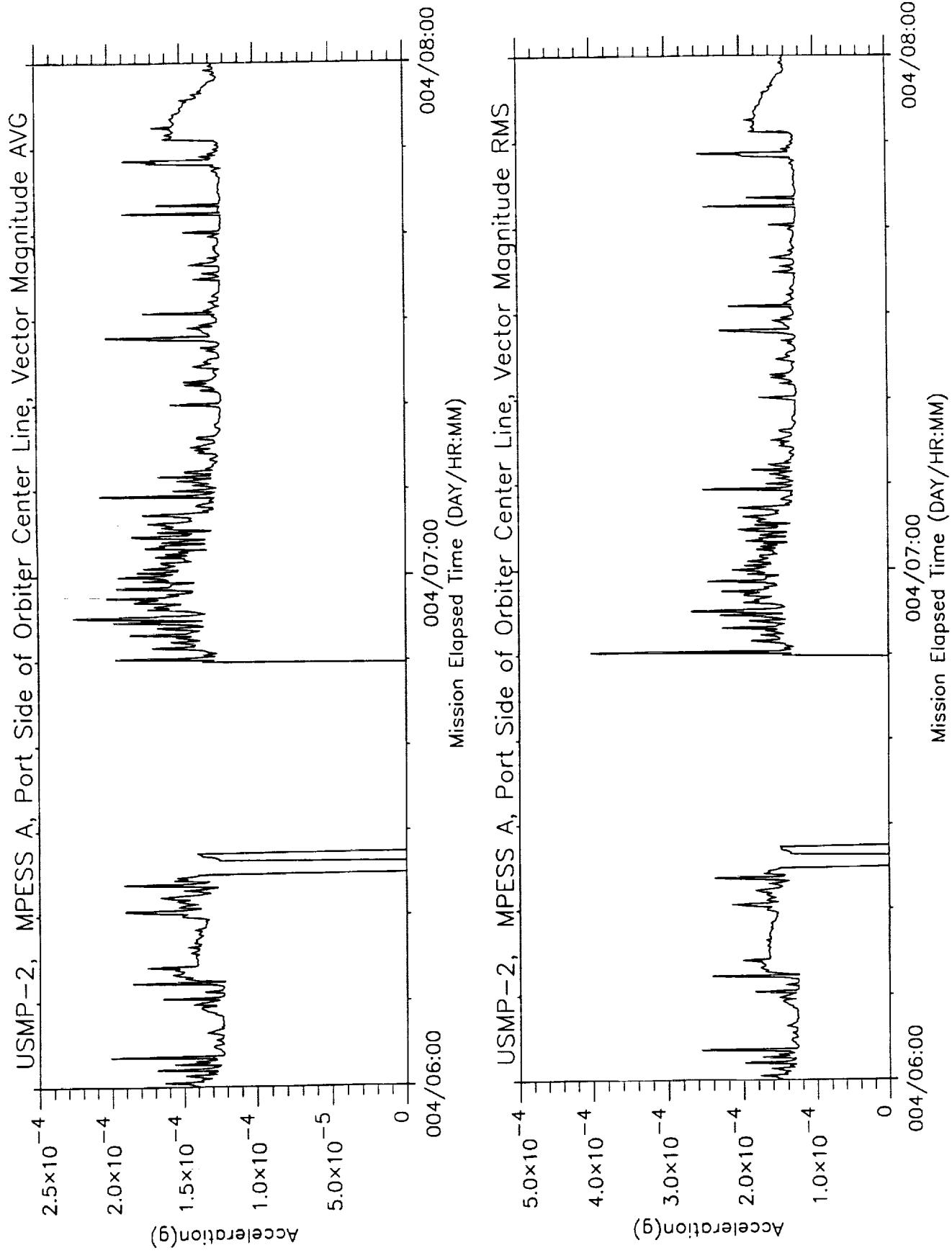
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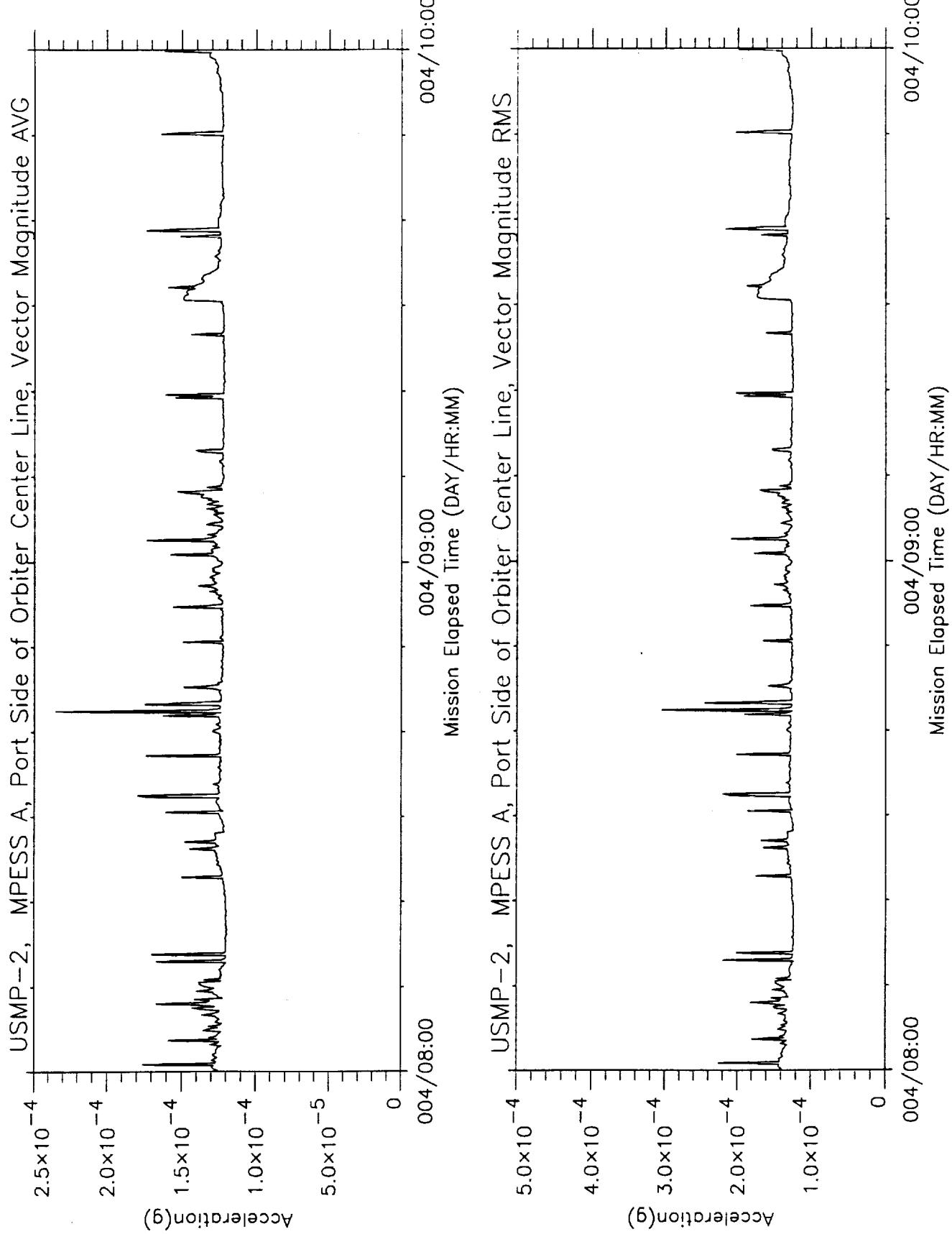
SUMMARY REPORT OF MISSION ACCELERATION MEASUREMENTS FOR STS-62



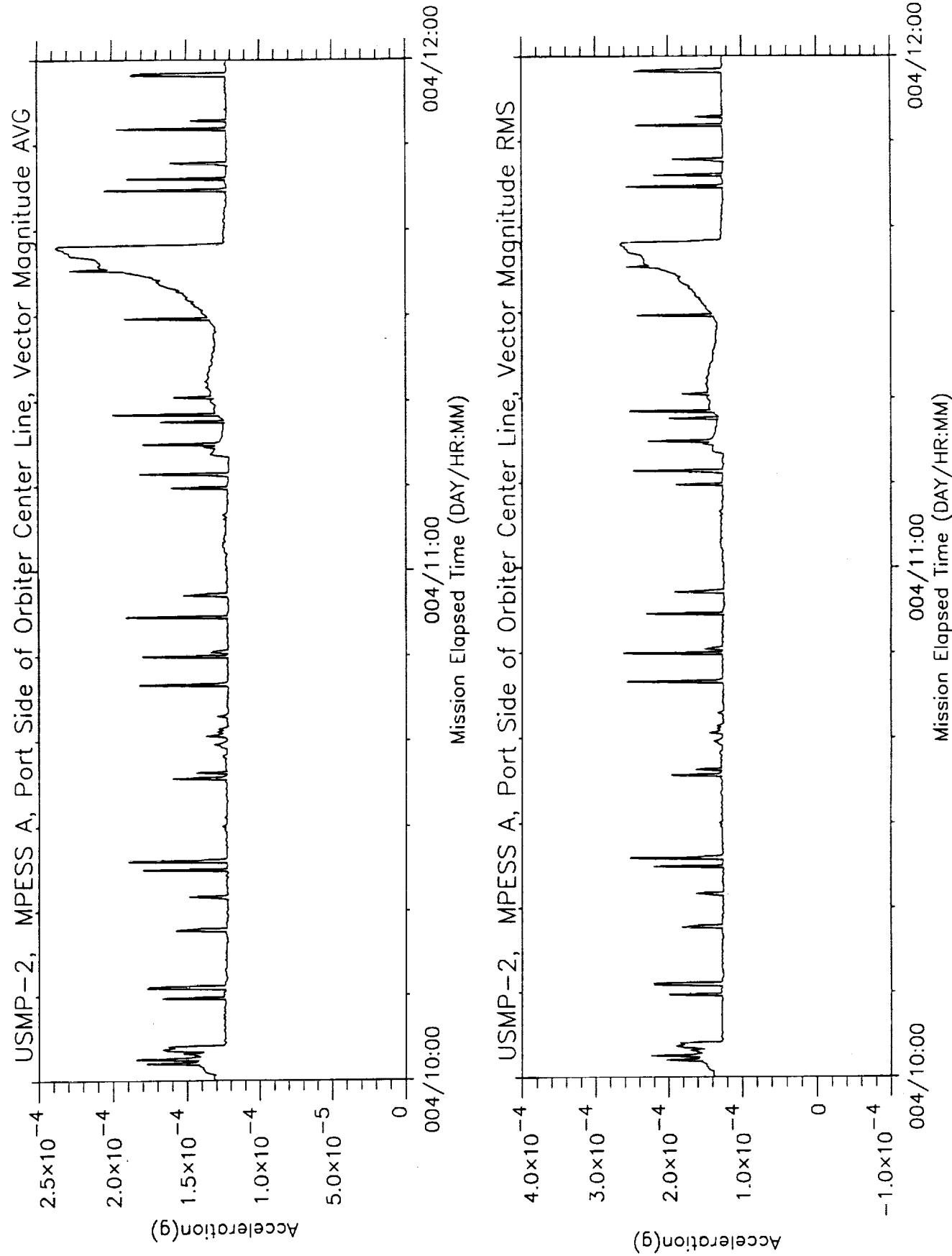
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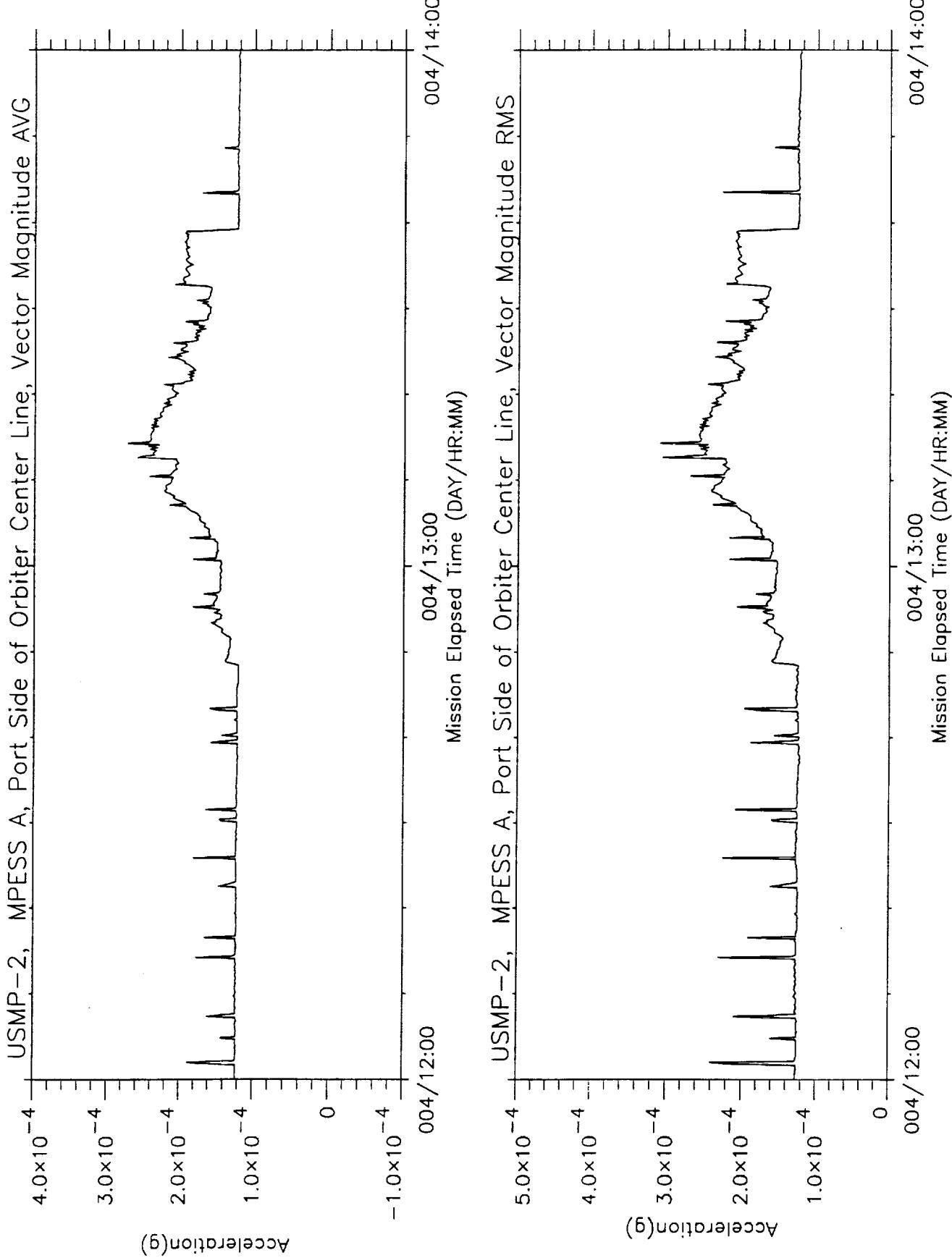
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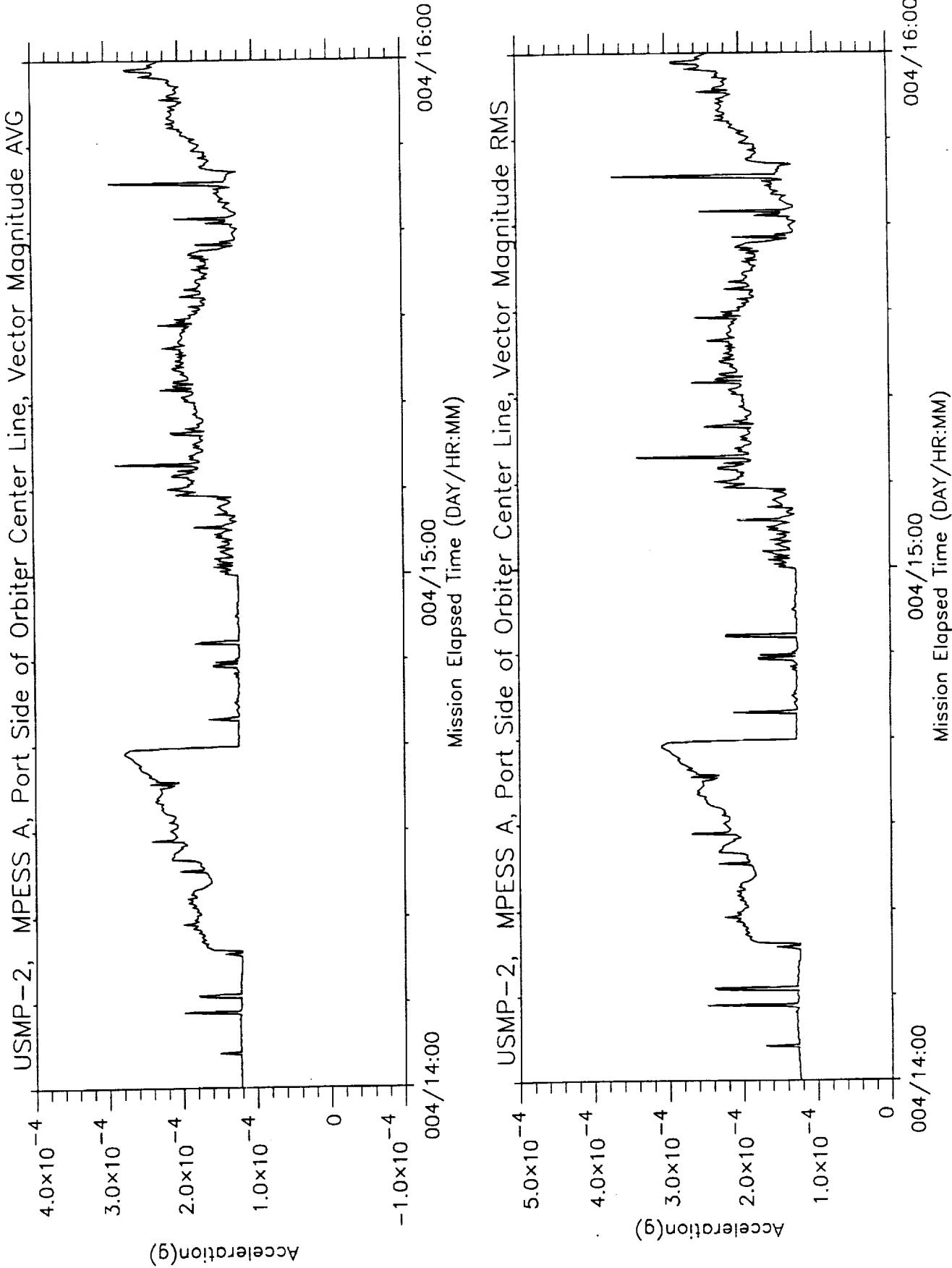
SUMMARY REPORT OF MISSION ACCELERATION MEASUREMENTS FOR STS-62



SUMMARY REPORT OF MISSION ACCELERATION MEASUREMENTS FOR STS-62



SUMMARY REPORT OF MISSION ACCELERATION MEASUREMENTS FOR STS-62



SUMMARY REPORT OF MISSION ACCELERATION MEASUREMENTS FOR STS-62

USMP-2, MPESS A, Port Side of Orbiter Center Line, Vector Magnitude AVG

4.0×10^{-4}

3.0×10^{-4}

2.0×10^{-4}

1.0×10^{-4}

0

004/16:00

004/17:00

004/18:00

B-39

USMP-2, MPESS A, Port Side of Orbiter Center Line, Vector Magnitude RMS

4.0×10^{-4}

3.0×10^{-4}

2.0×10^{-4}

1.0×10^{-4}

0

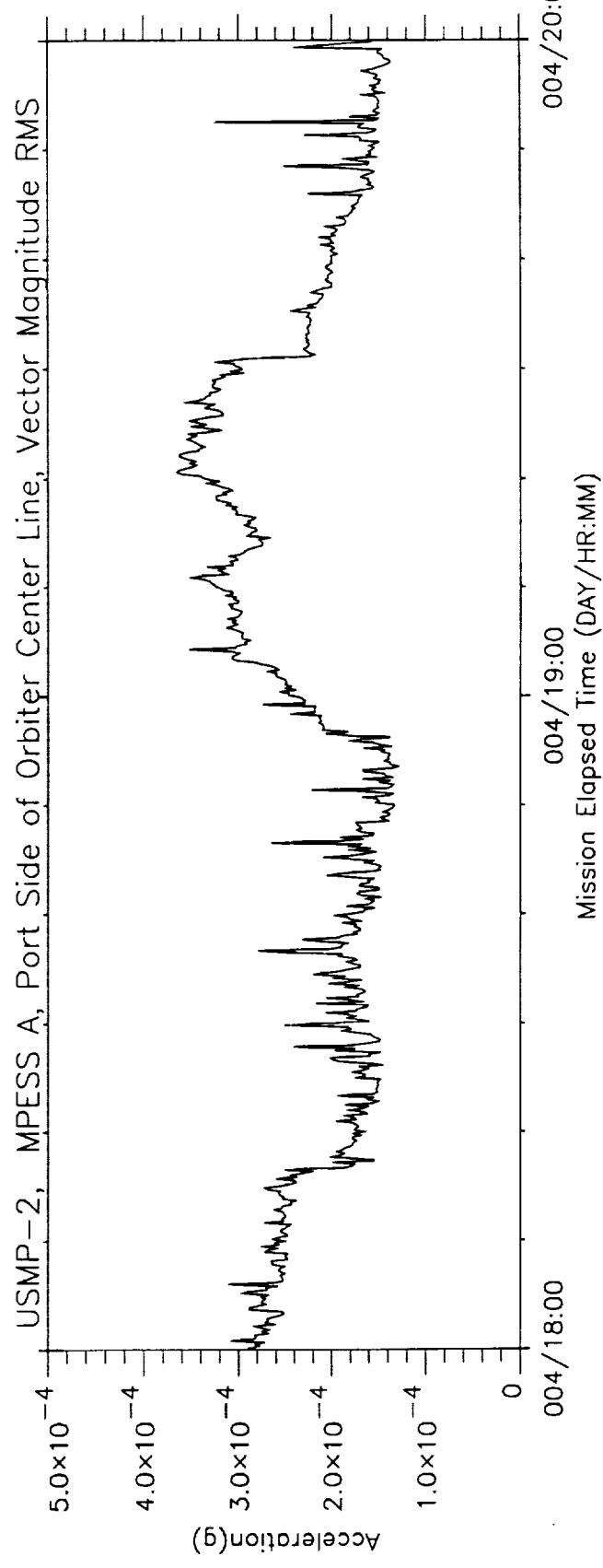
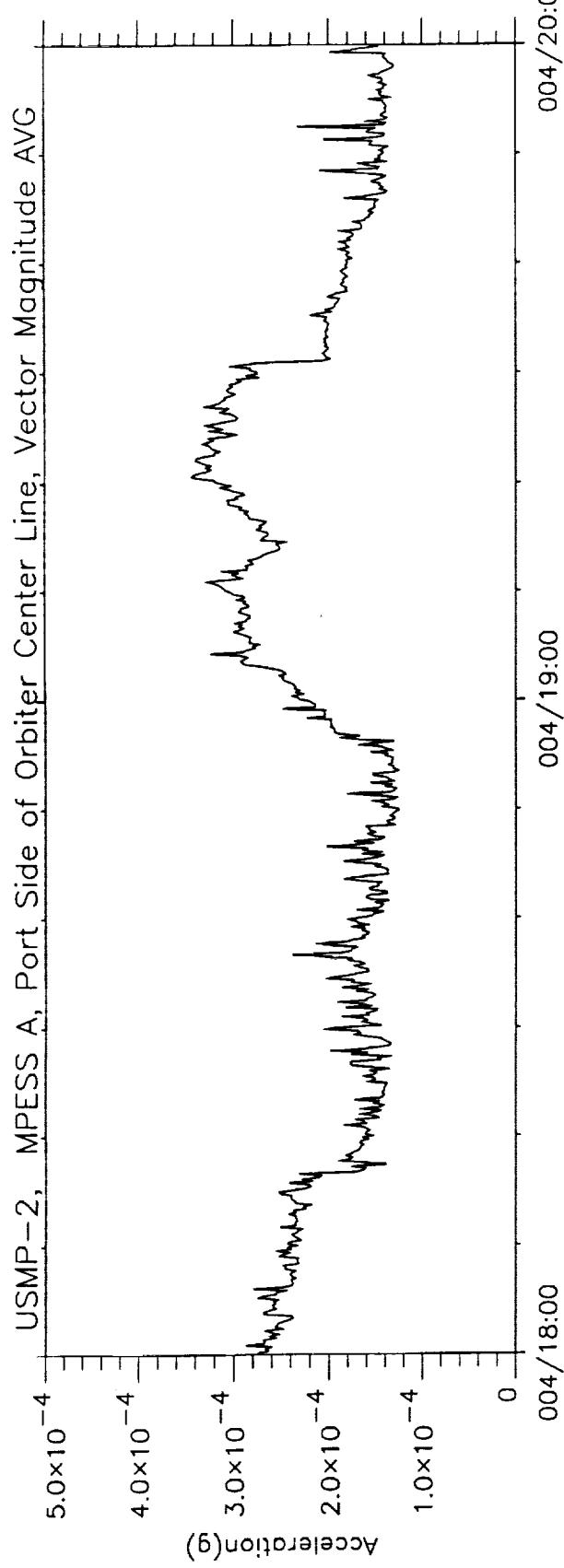
004/16:00

004/17:00

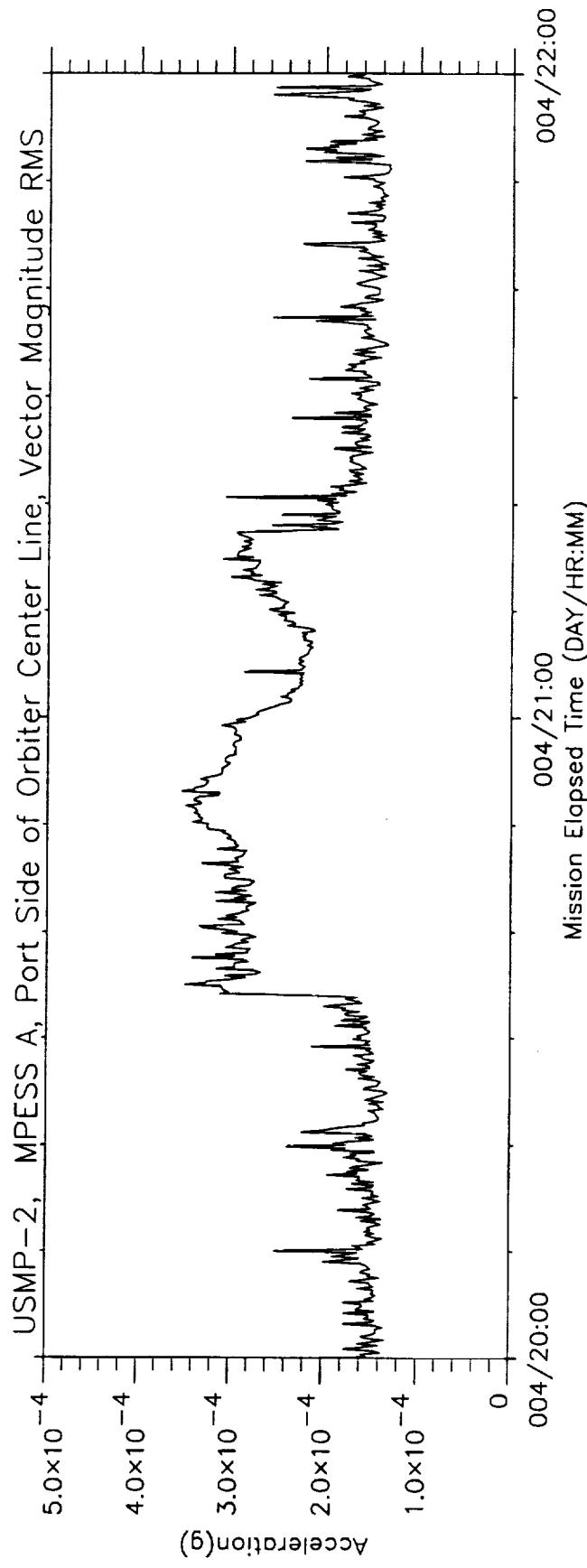
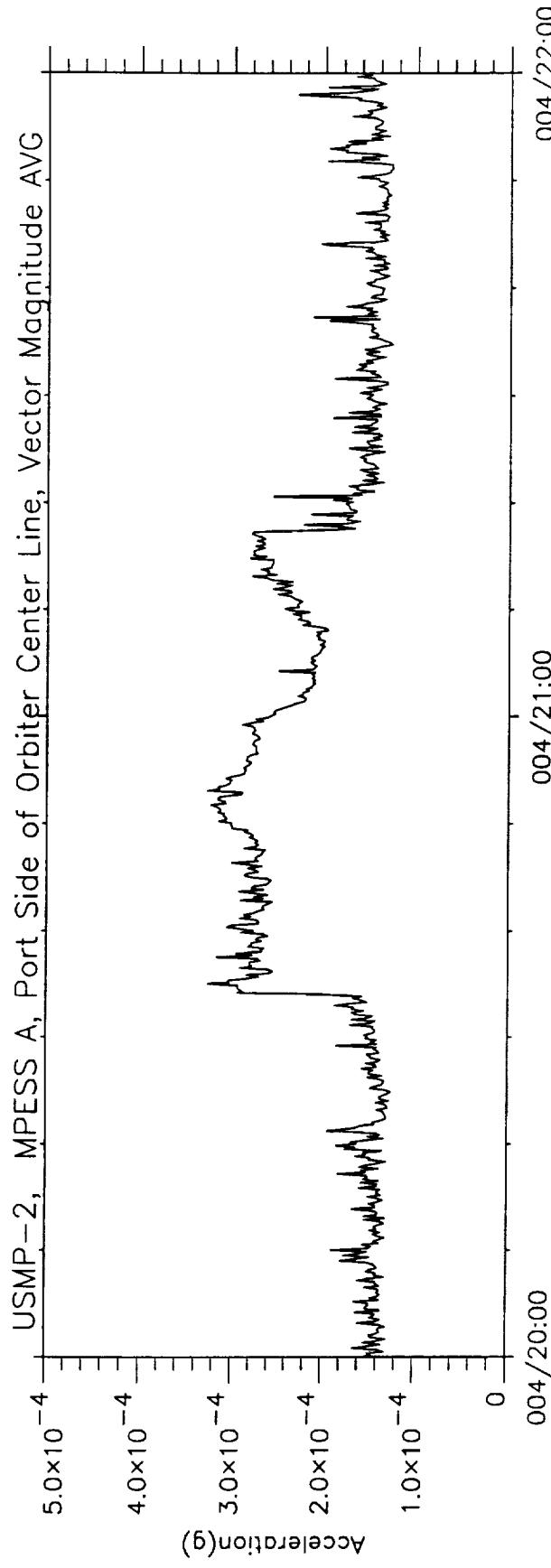
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Mission Elapsed Time (DAY/HR:MM)

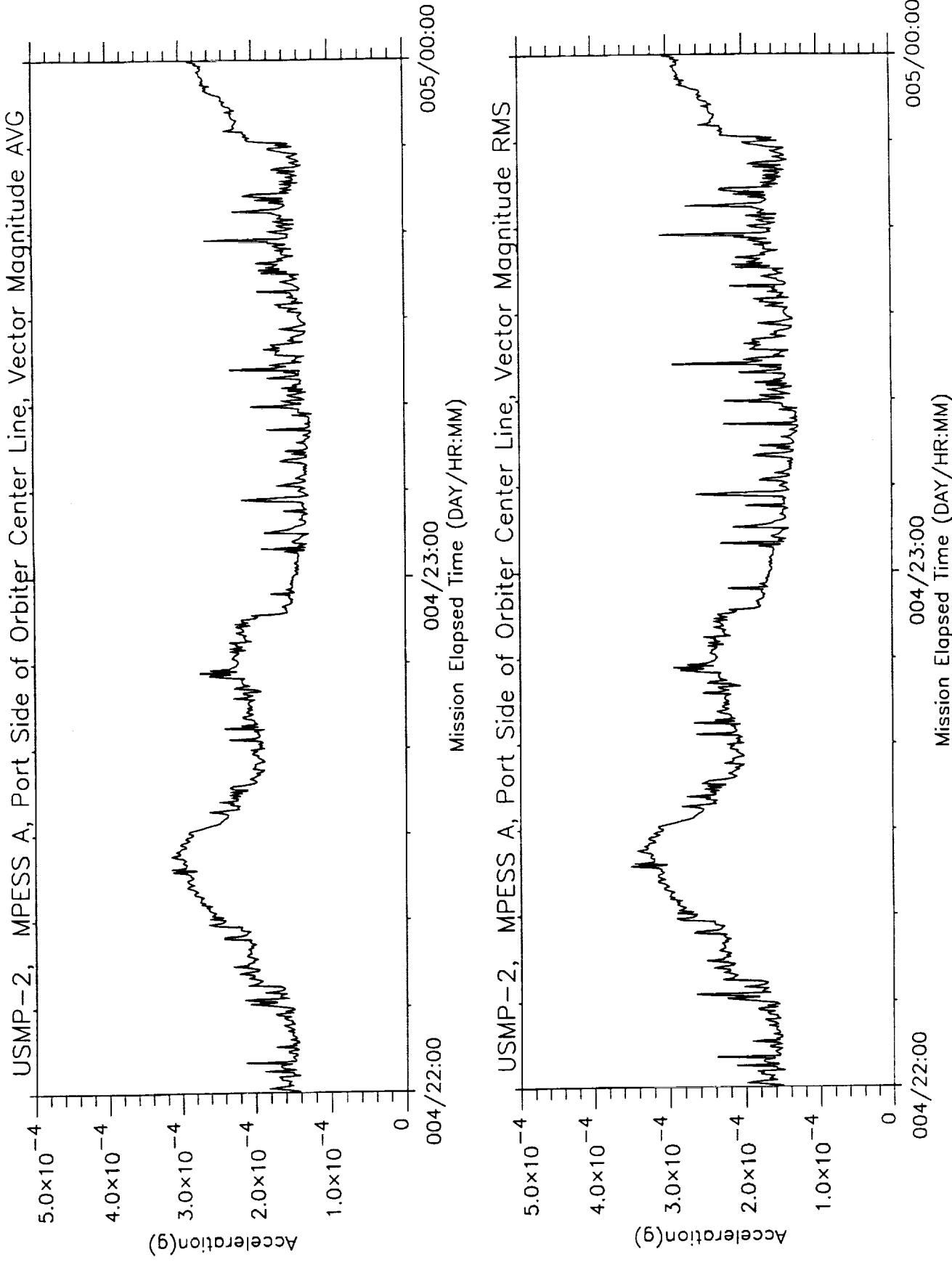
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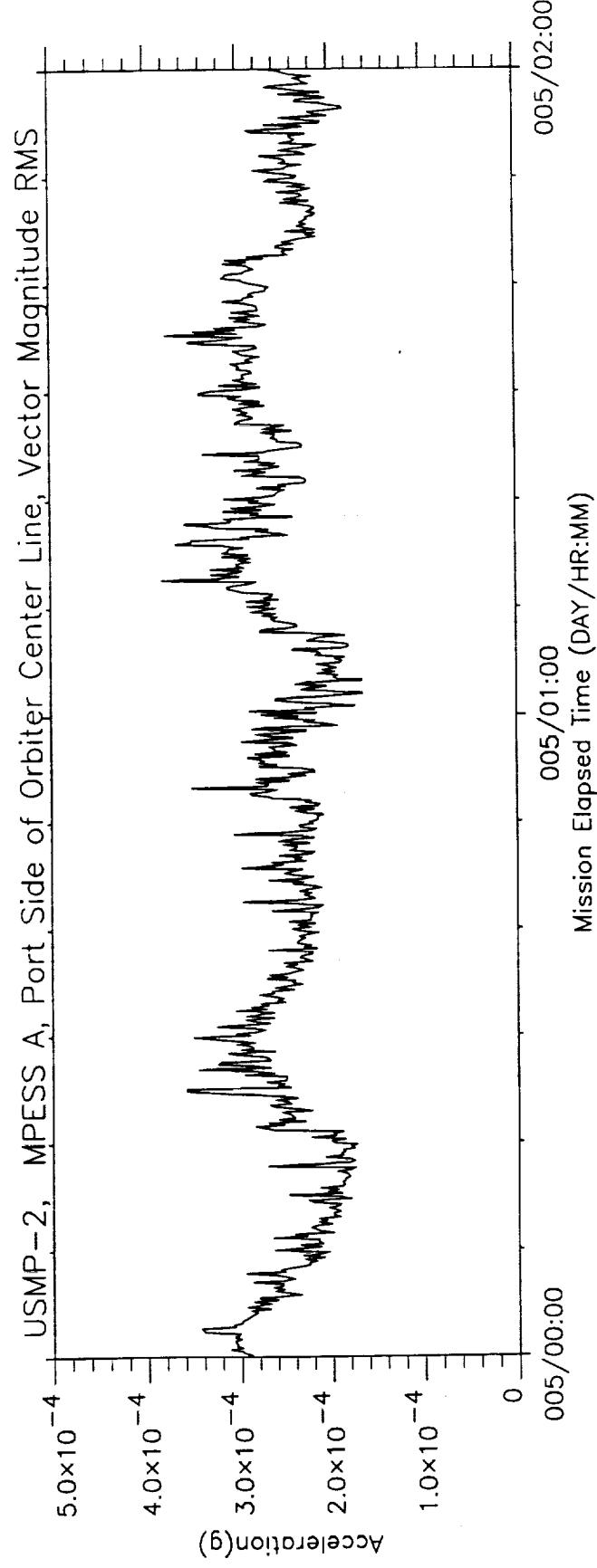
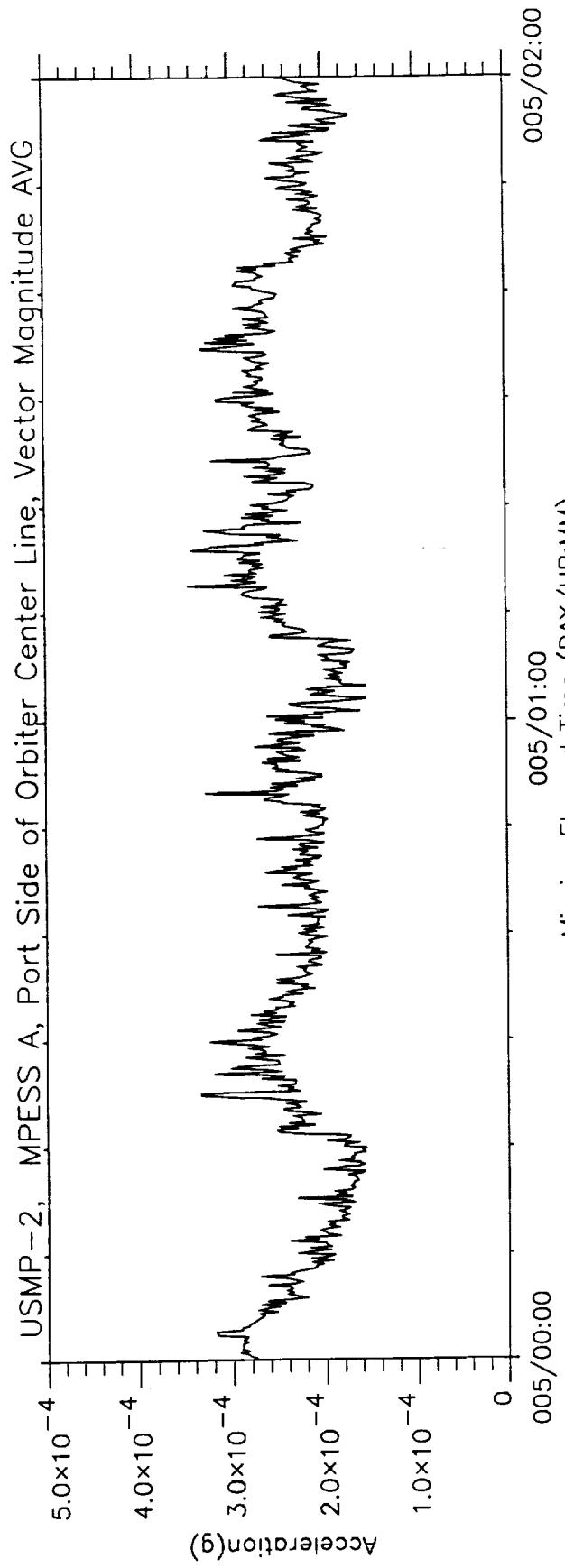
SUMMARY REPORT OF MISSION ACCELERATION MEASUREMENTS FOR STS-62



SUMMARY REPORT OF MISSION ACCELERATION MEASUREMENTS FOR STS-62

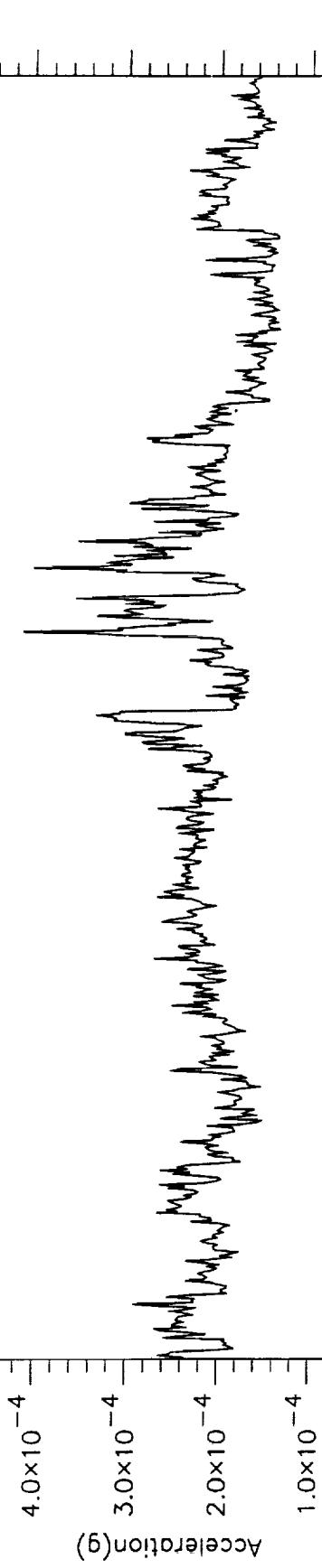


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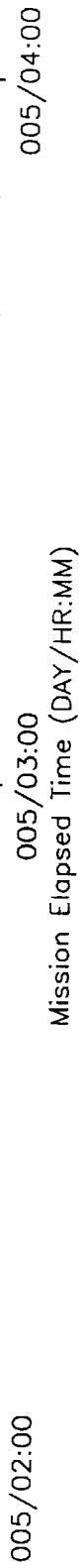
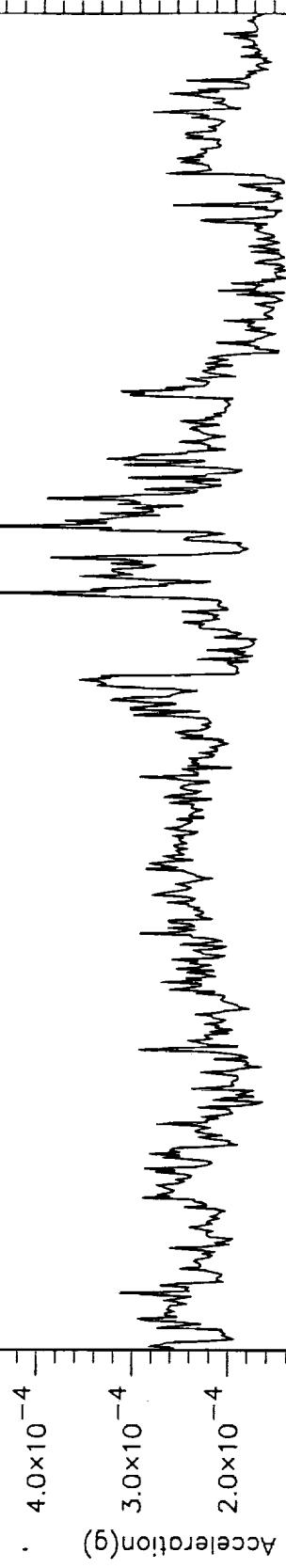


SUMMARY REPORT OF MISSION ACCELERATION MEASUREMENTS FOR STS-62

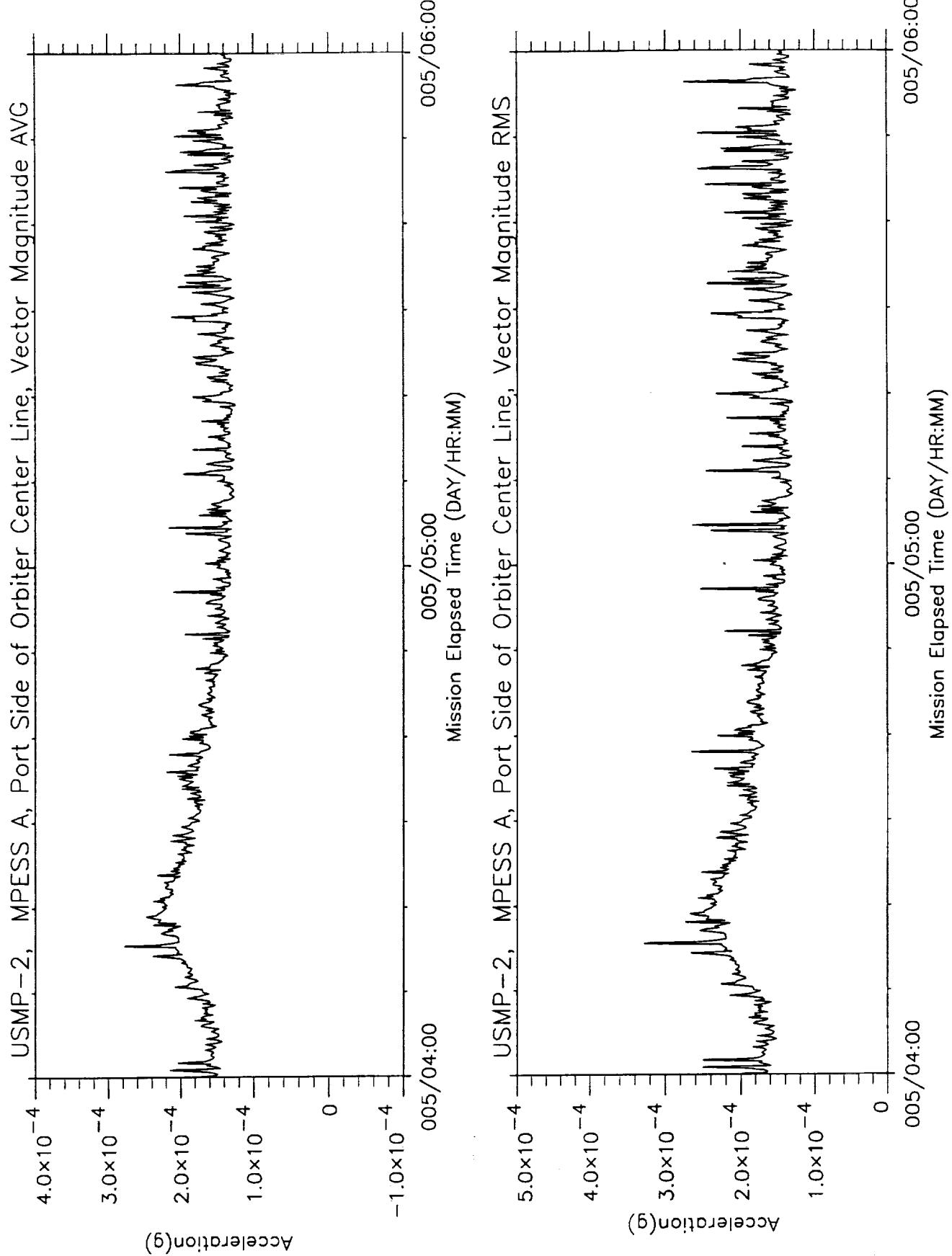
USMP-2, MPESS A, Port Side of Orbiter Center Line, Vector Magnitude AVG



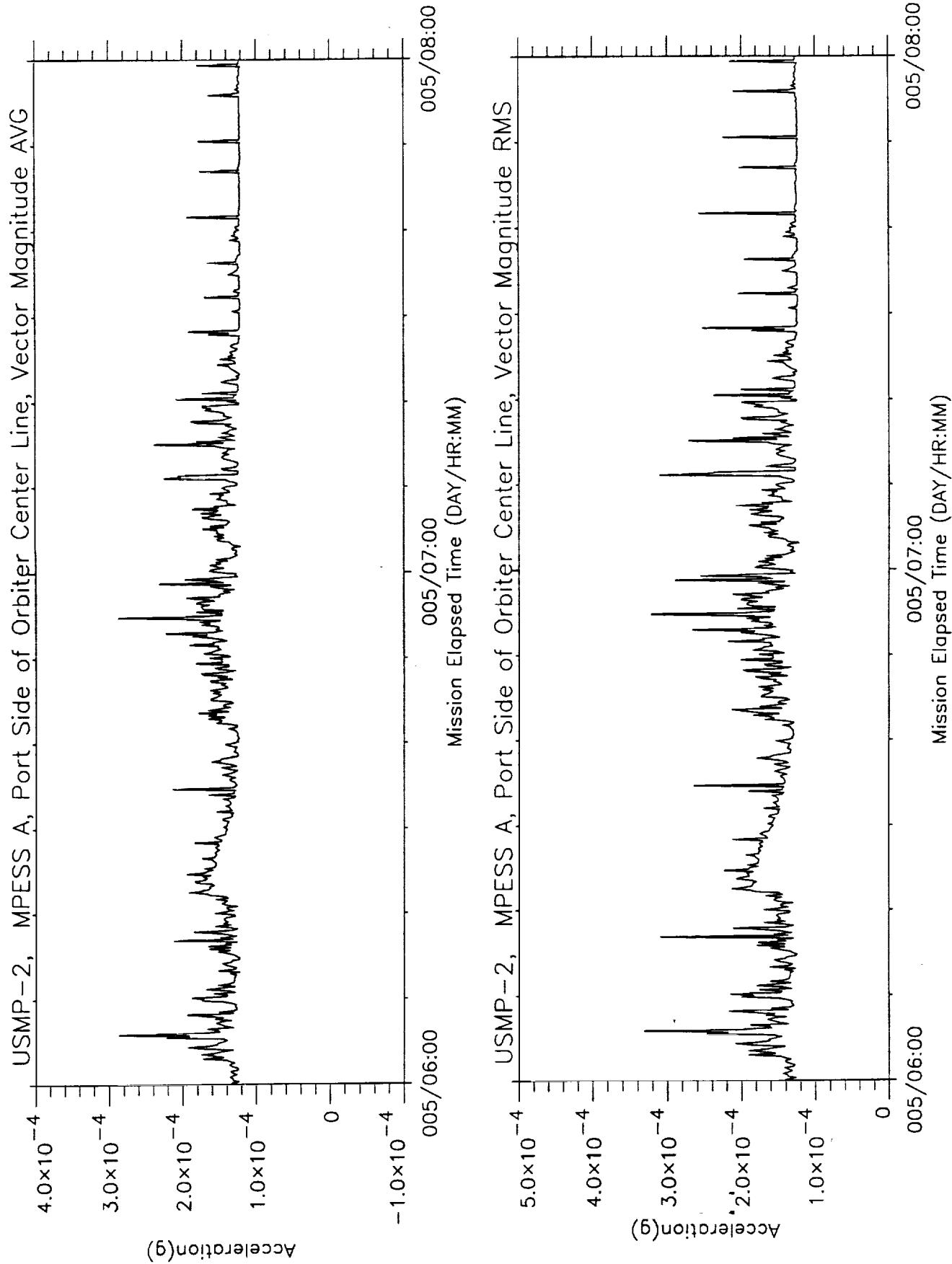
USMP-2, MPESS A, Port Side of Orbiter Center Line, Vector Magnitude RMS



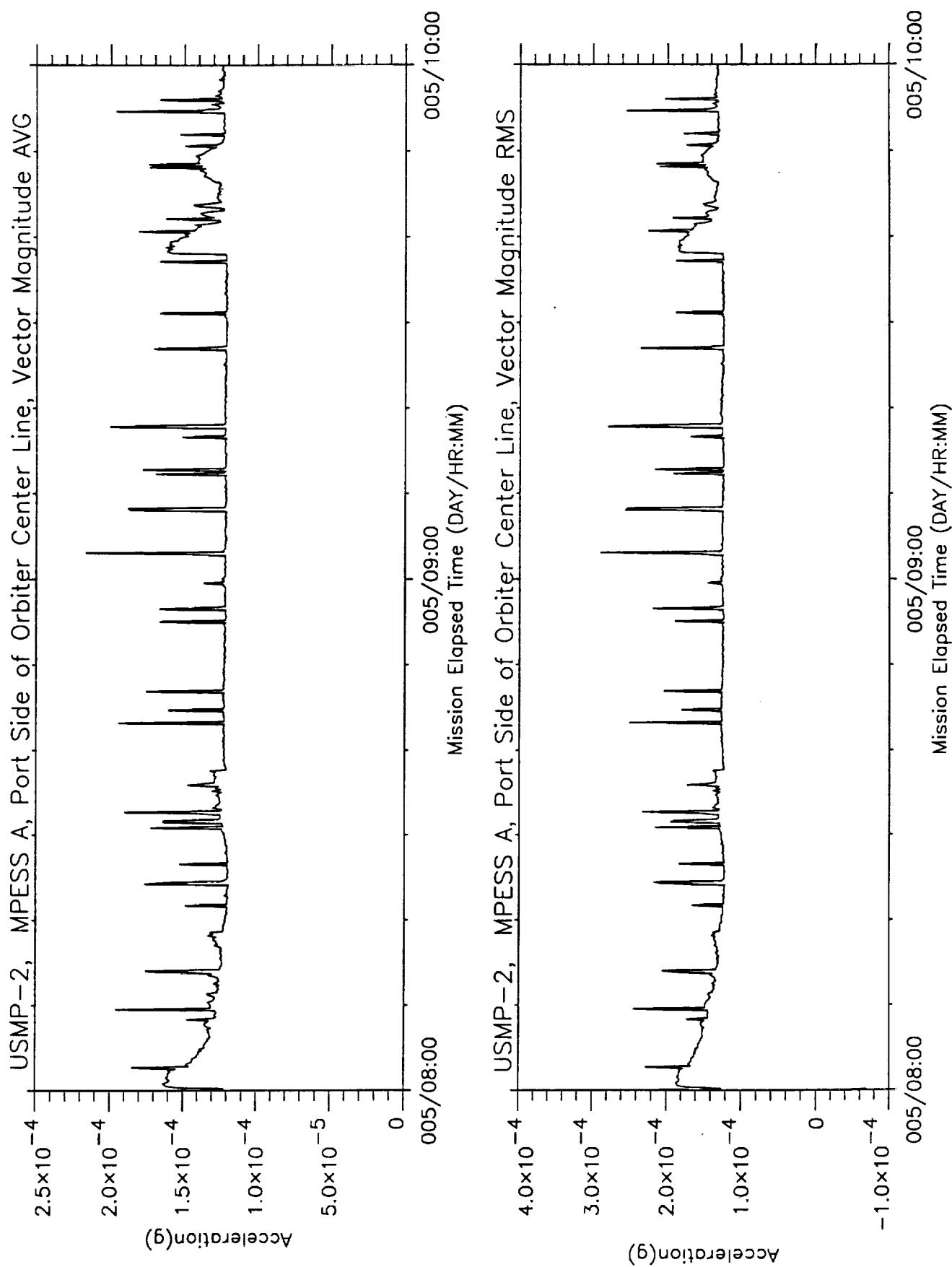
SUMMARY REPORT OF MISSION ACCELERATION MEASUREMENTS FOR STS-62



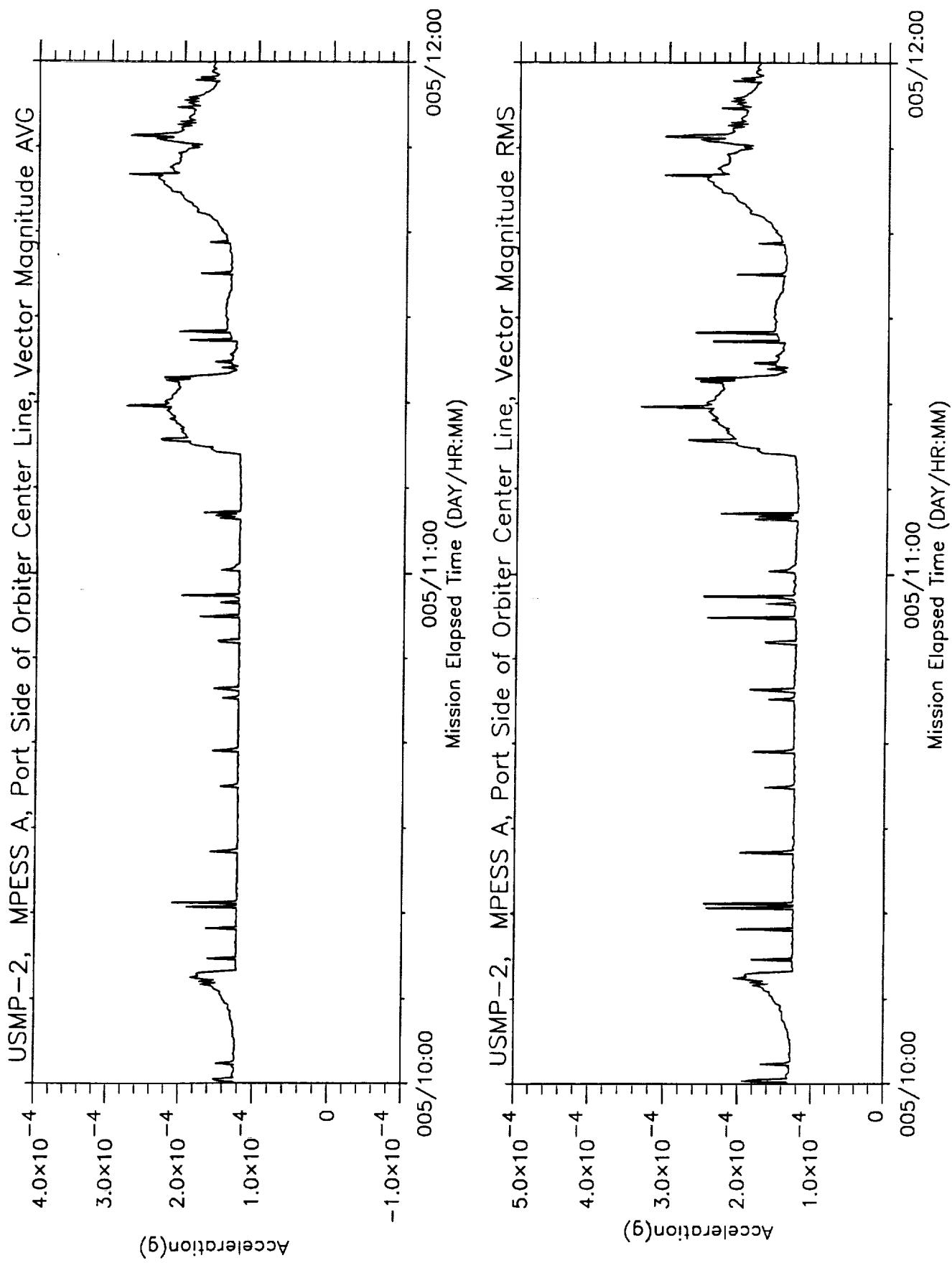
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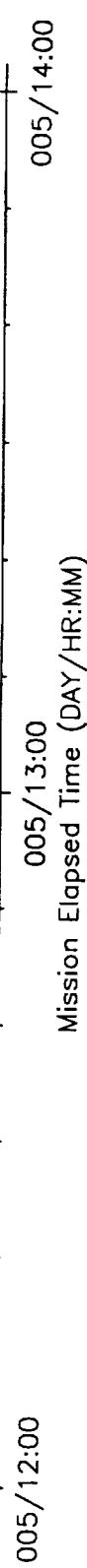
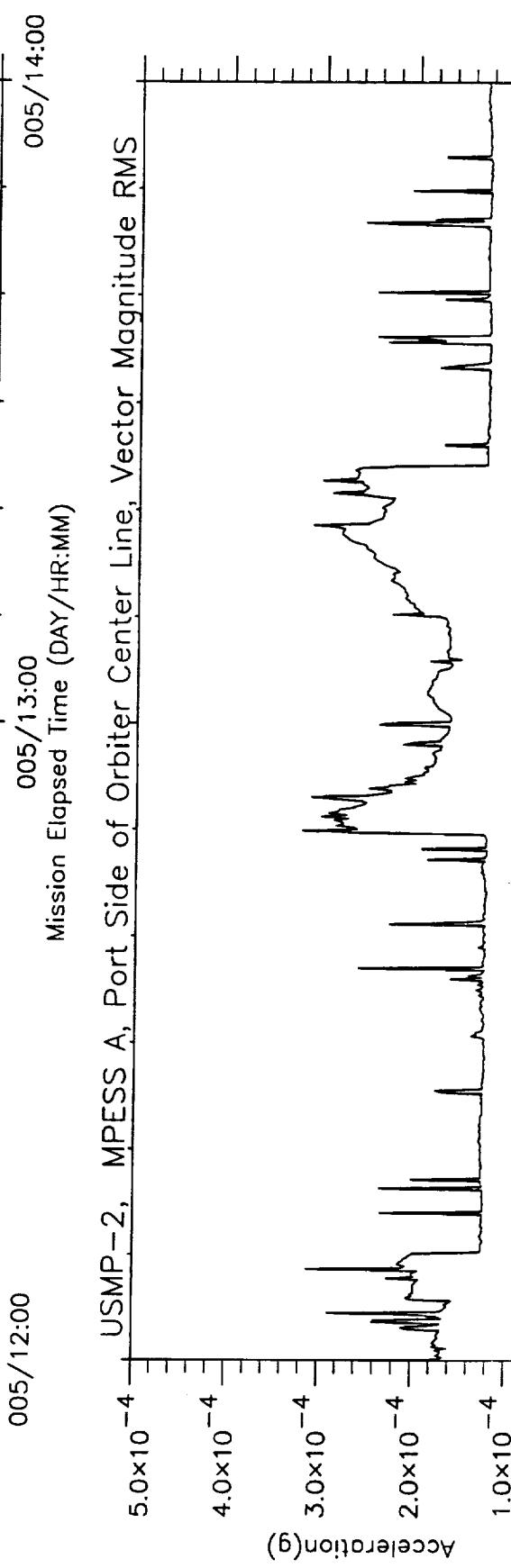
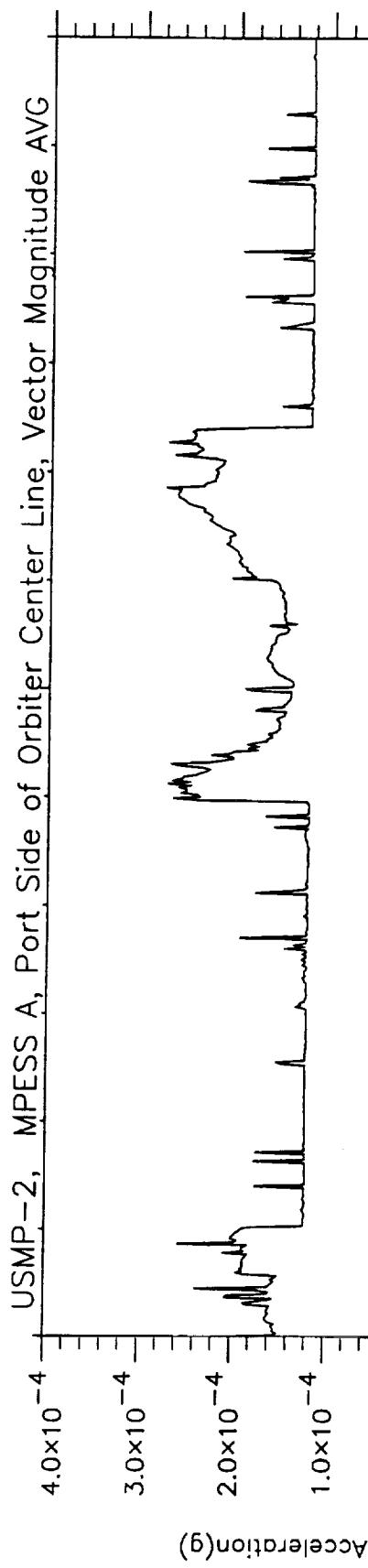
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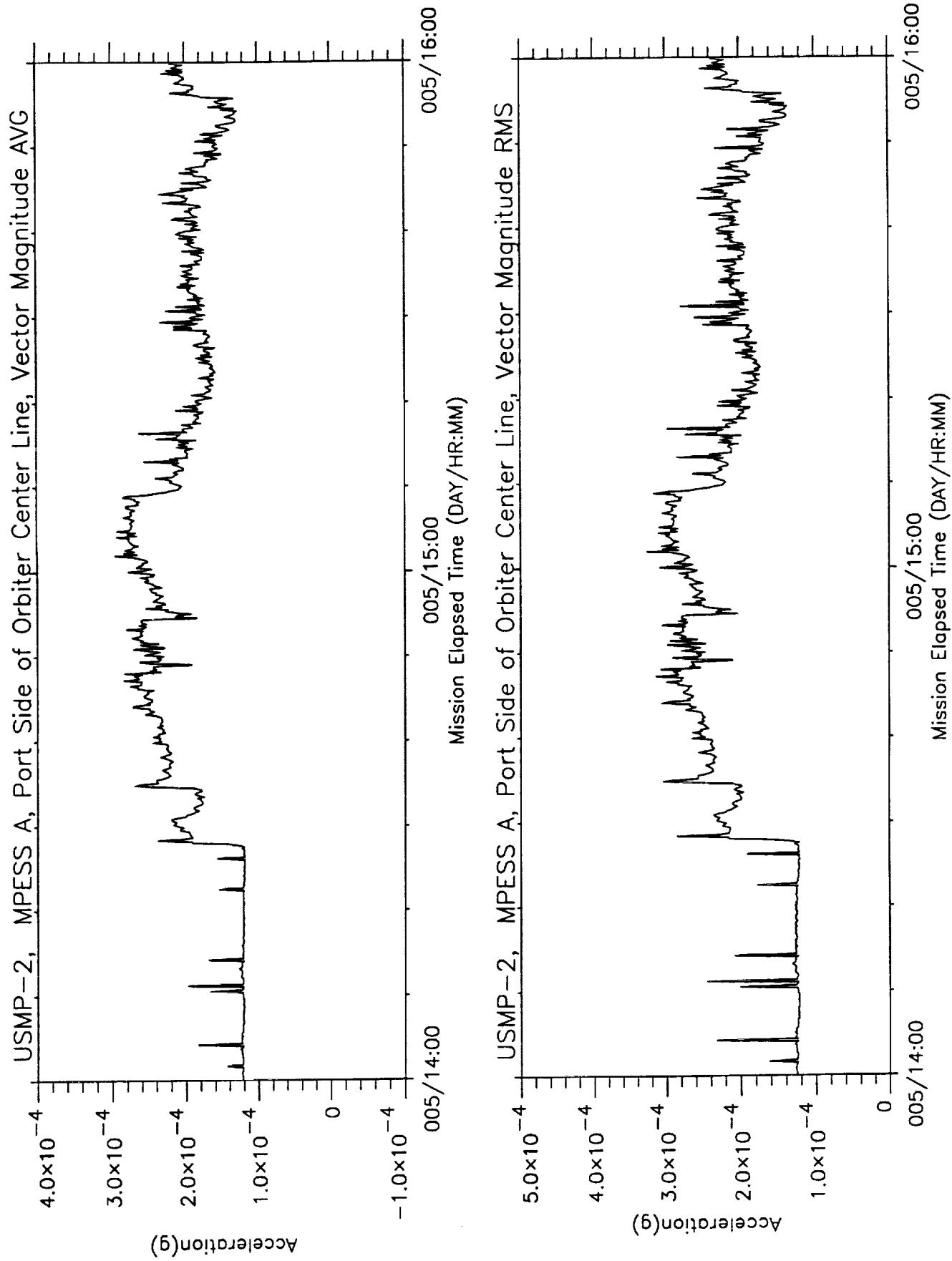
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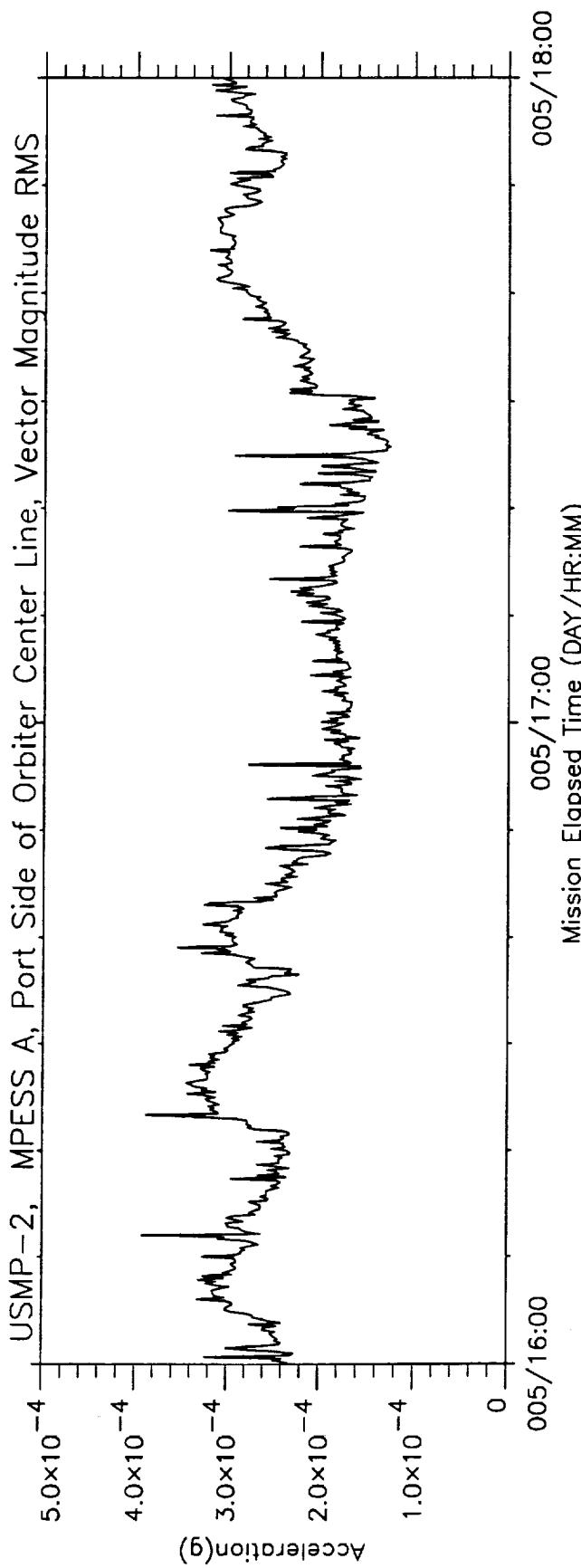
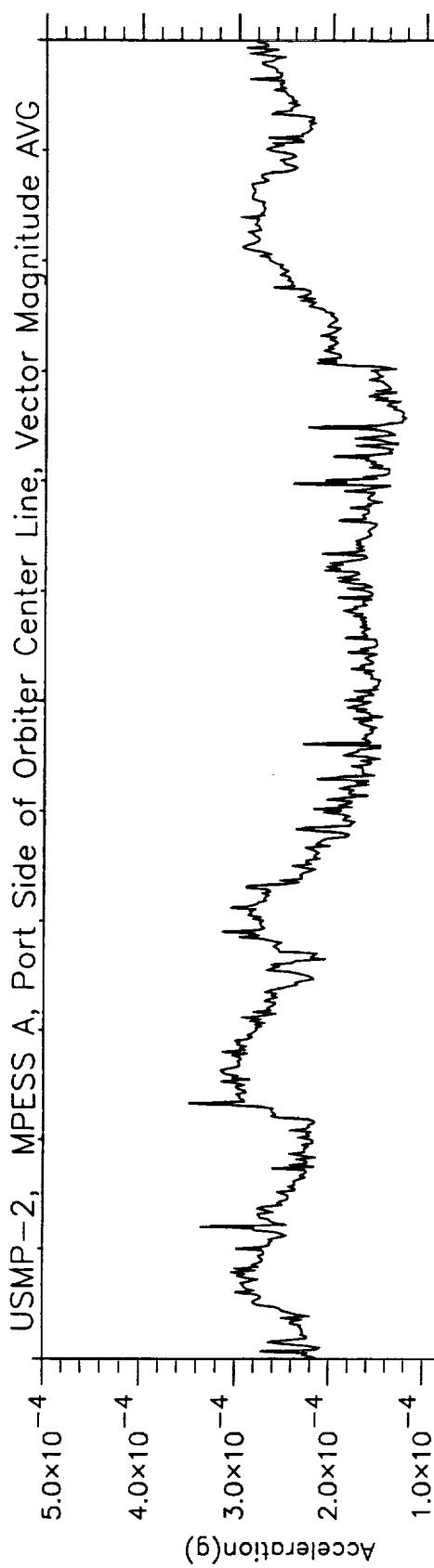
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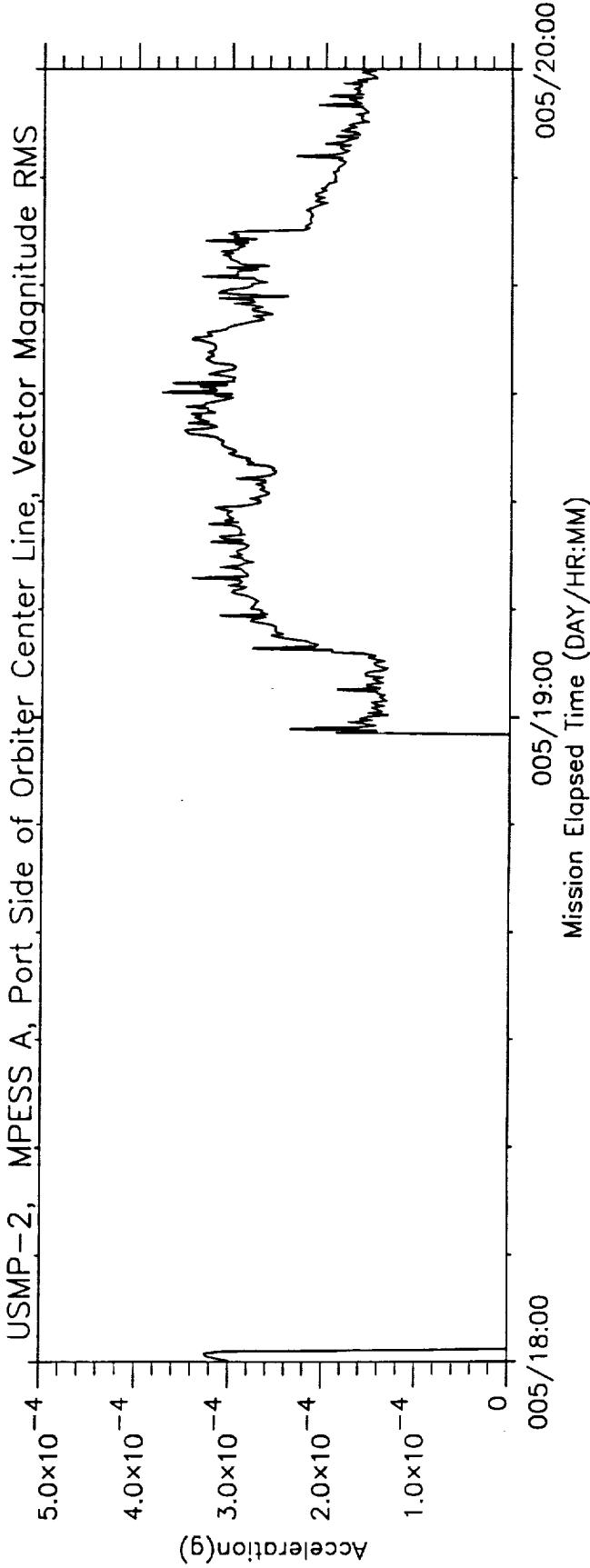
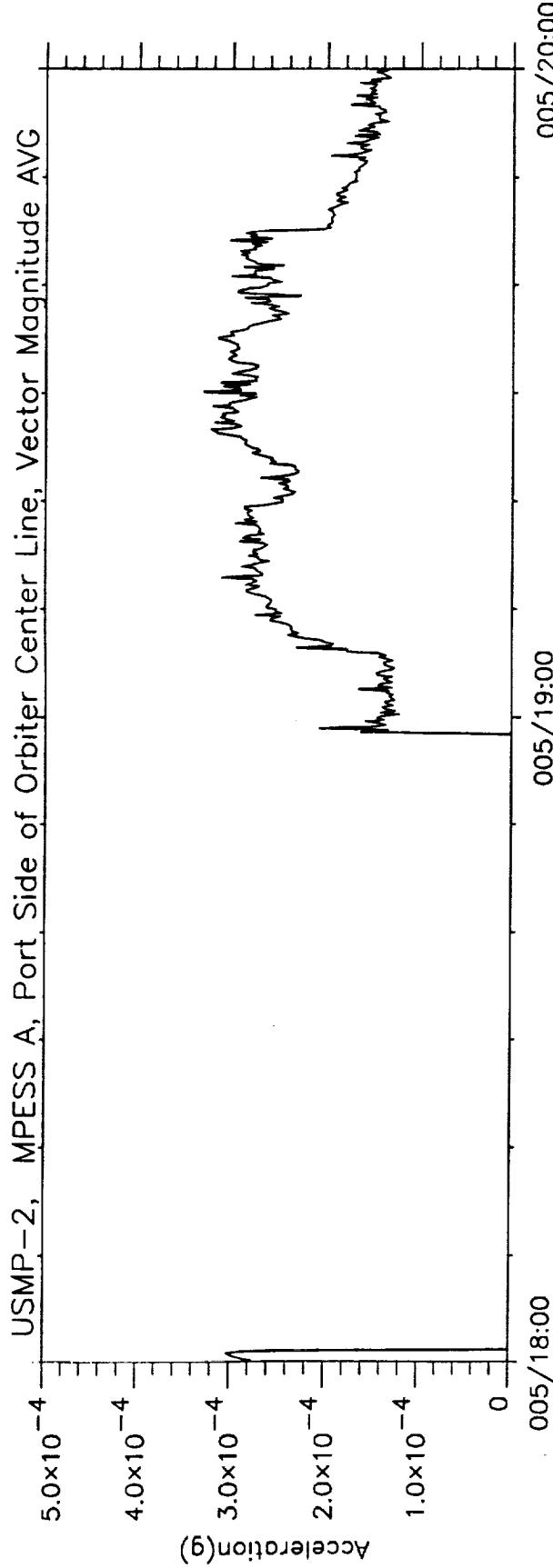
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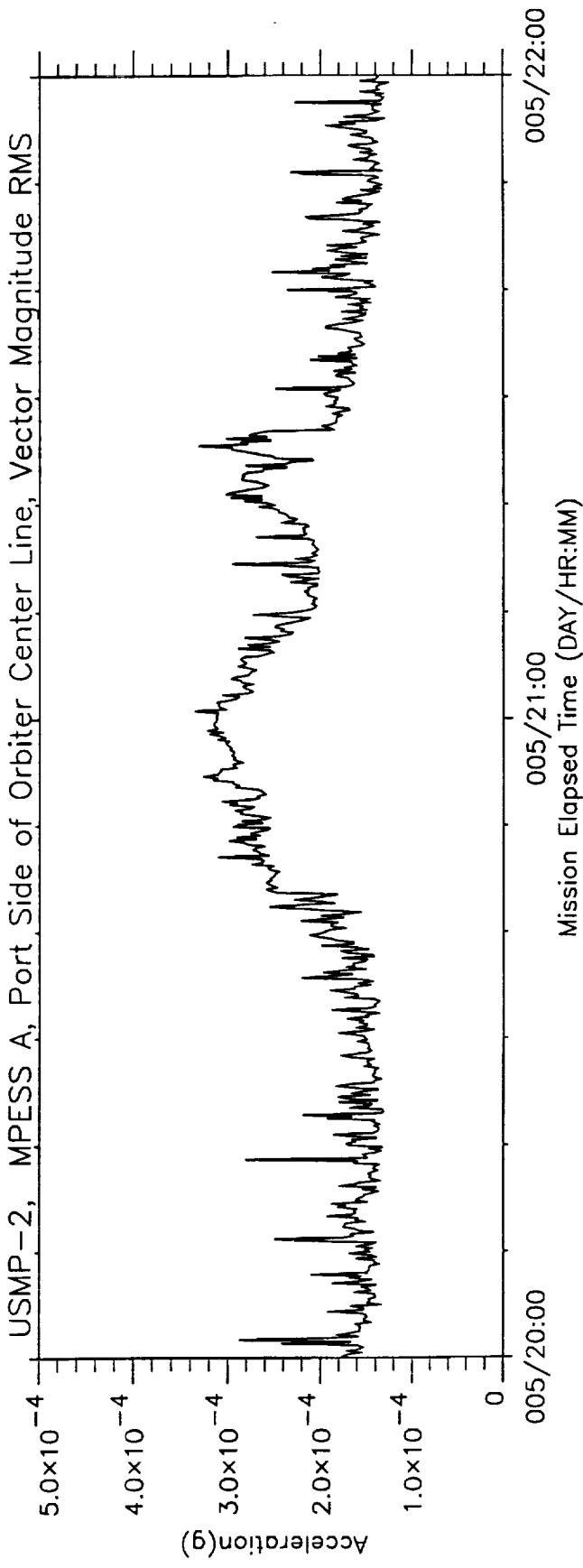
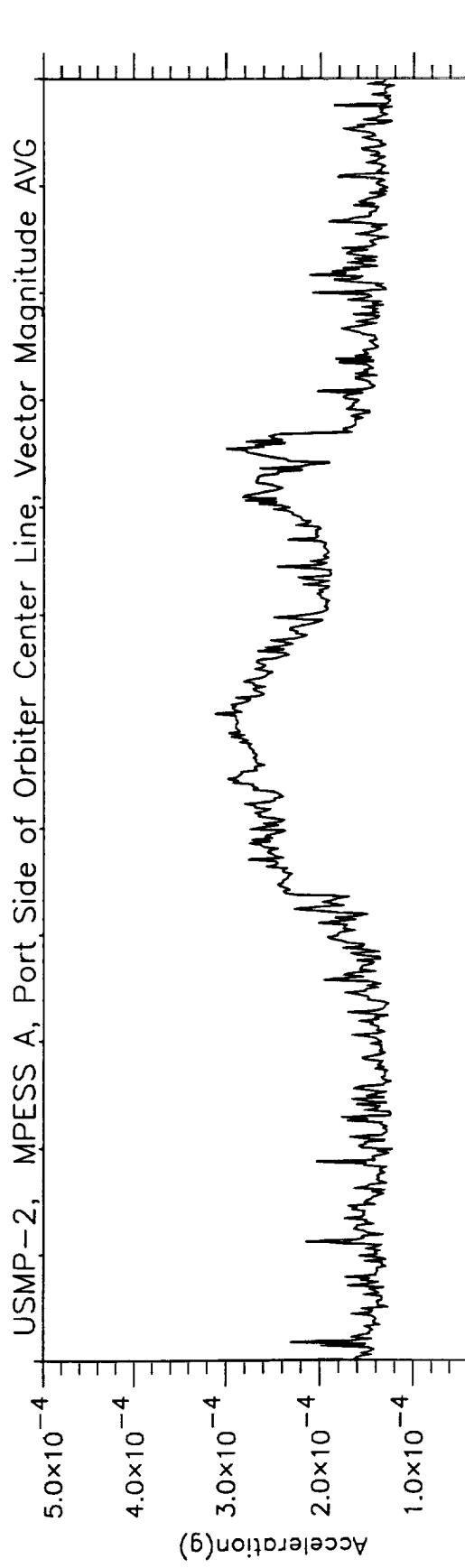
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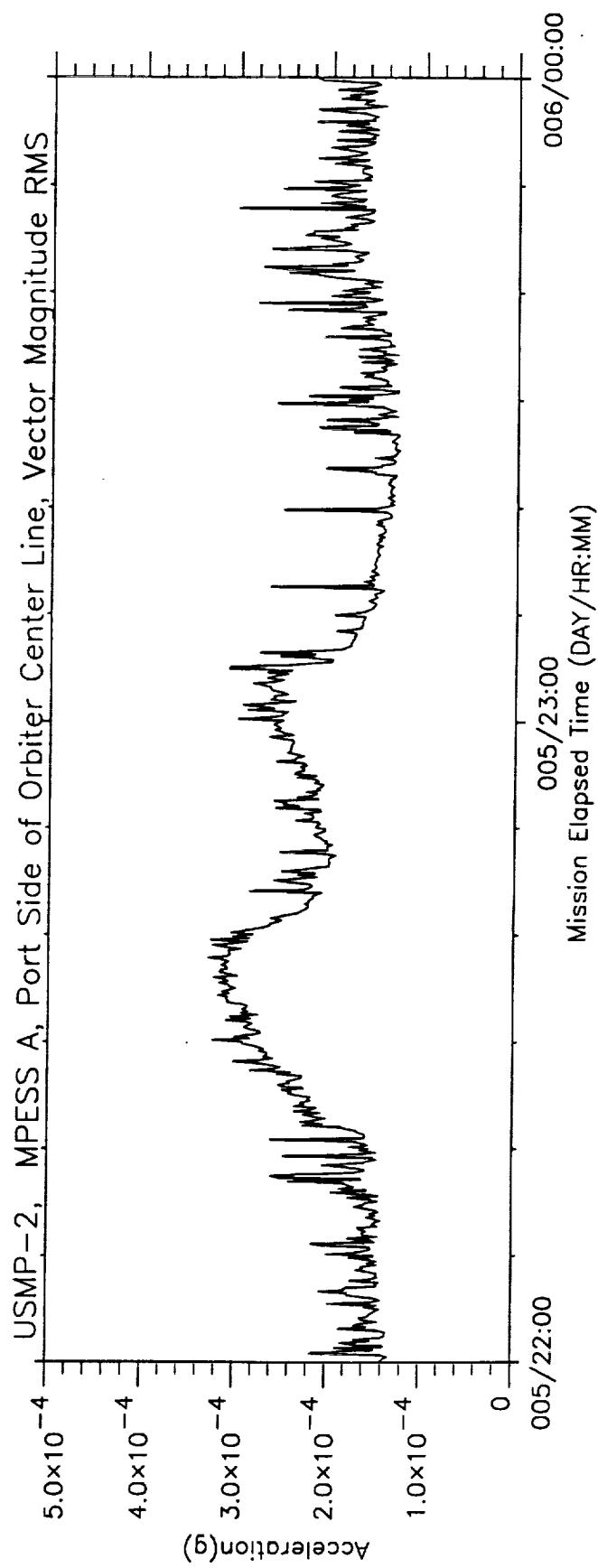
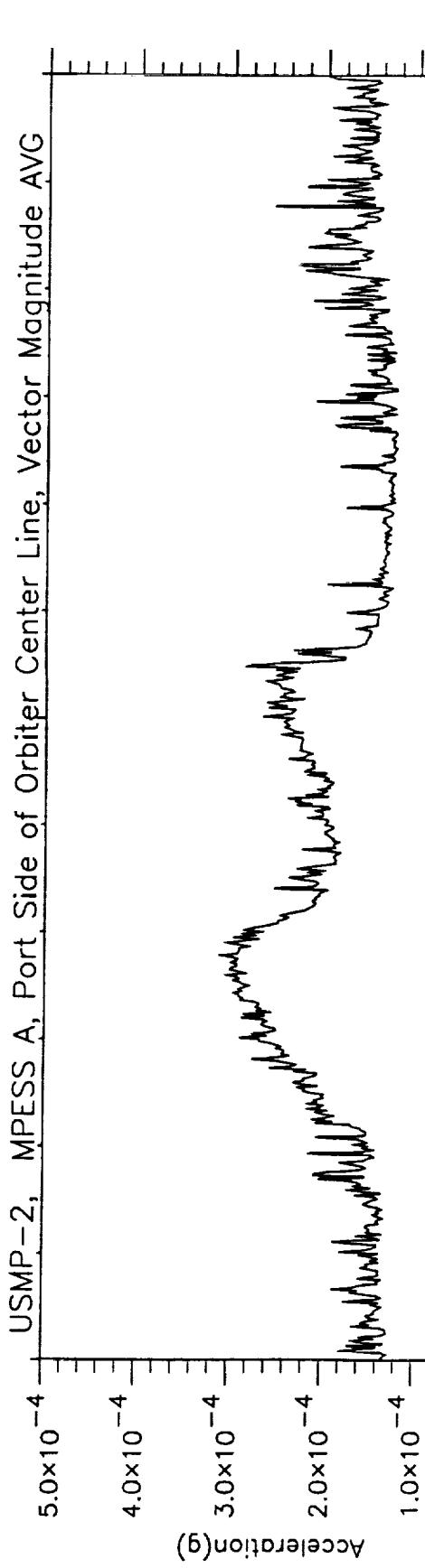
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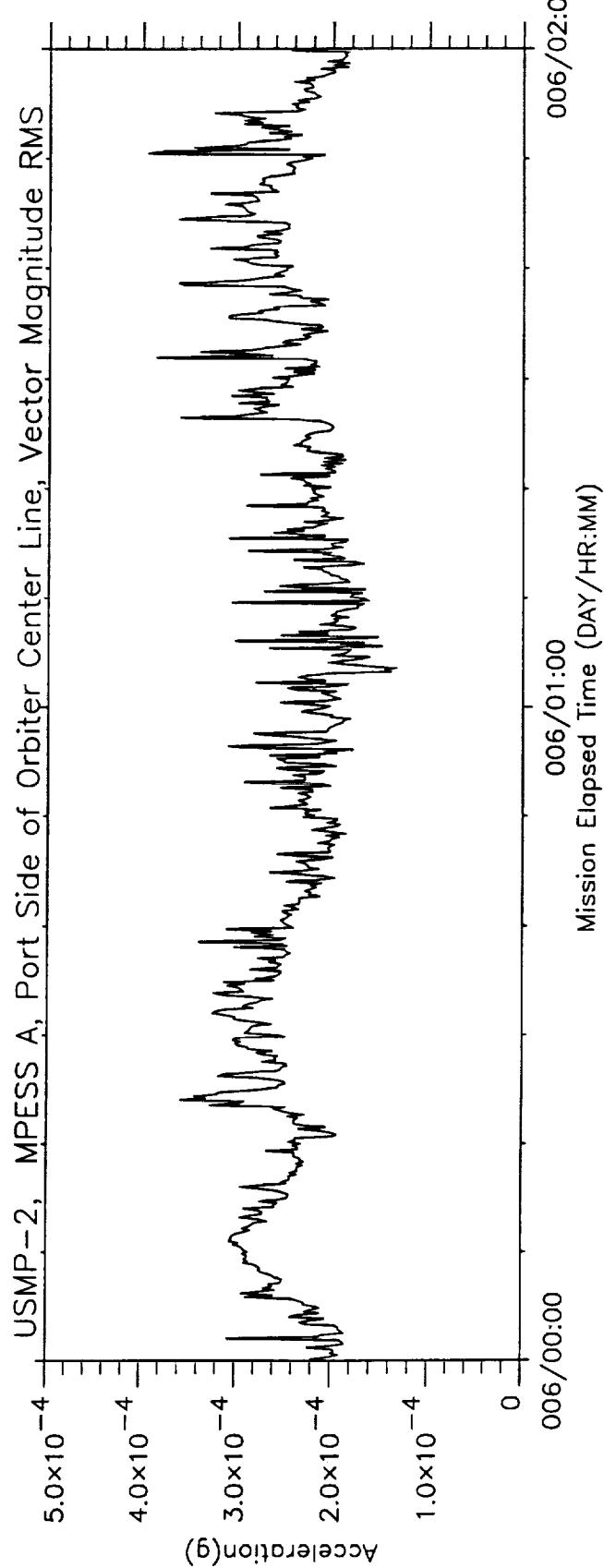
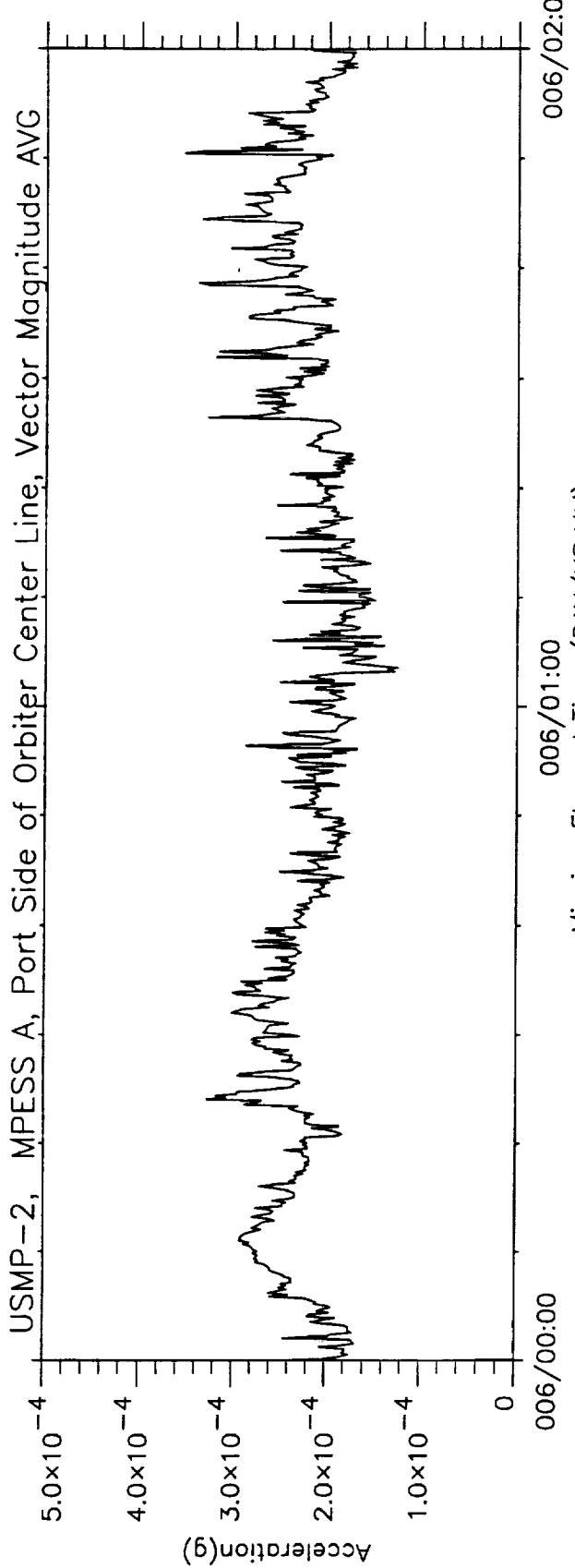
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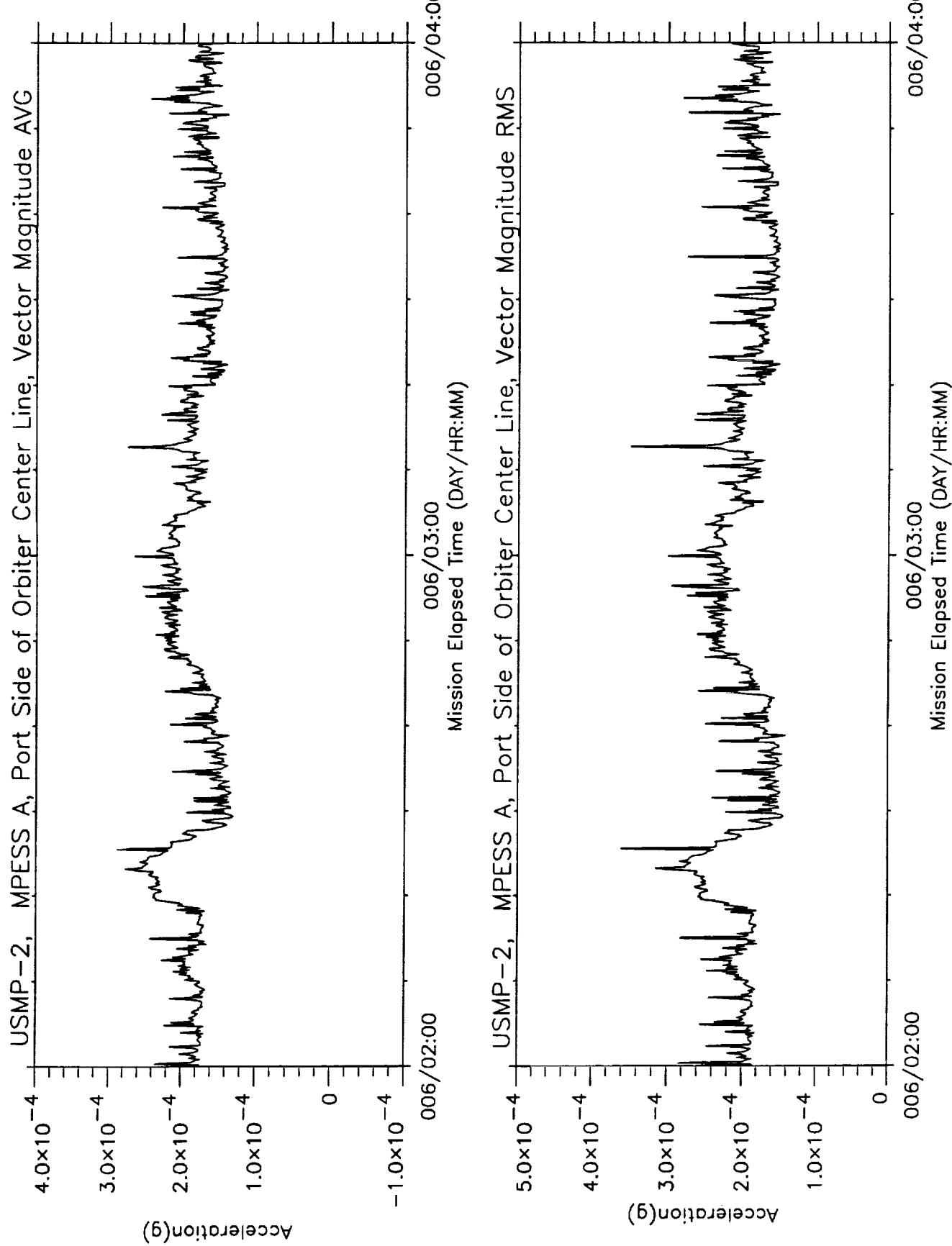
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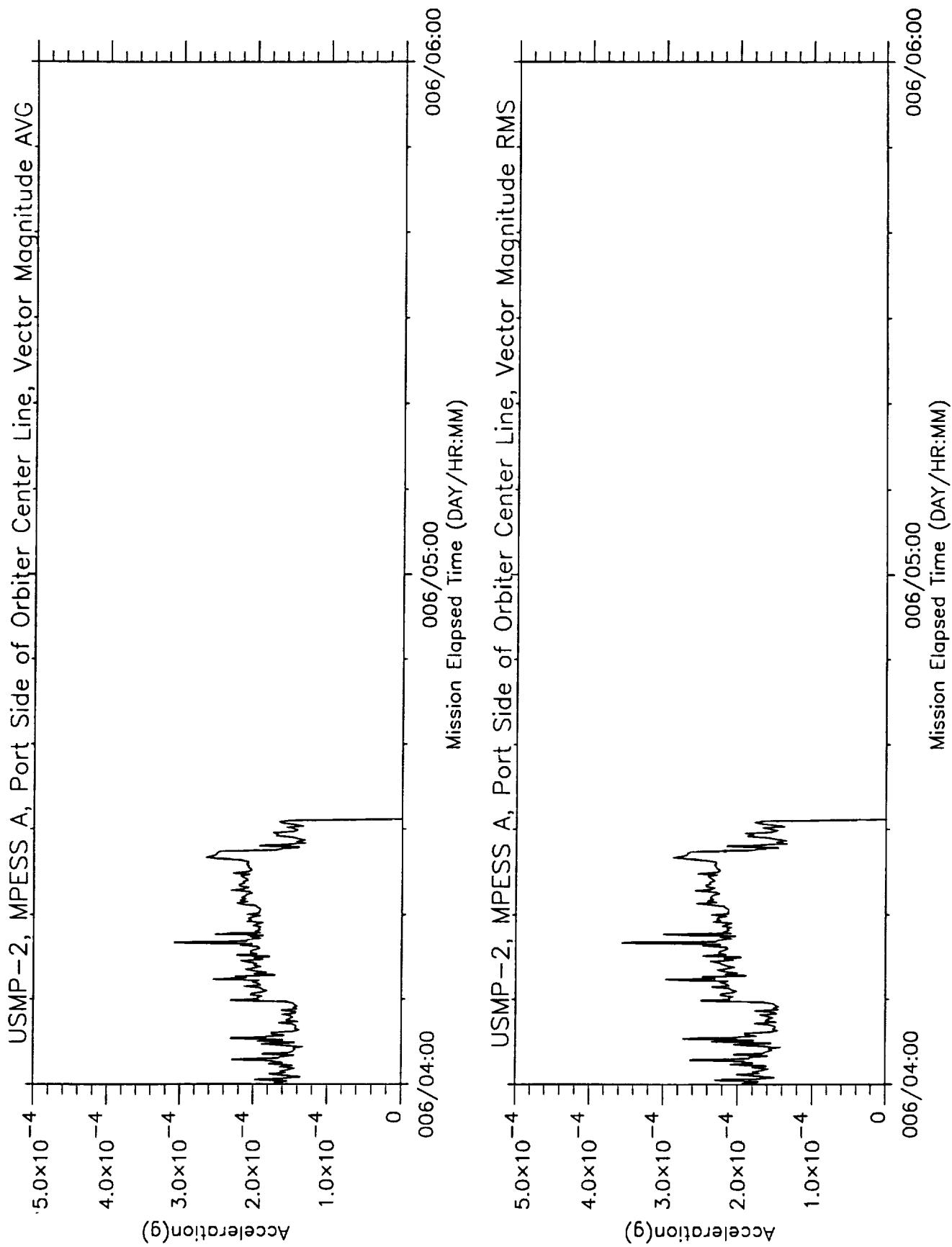
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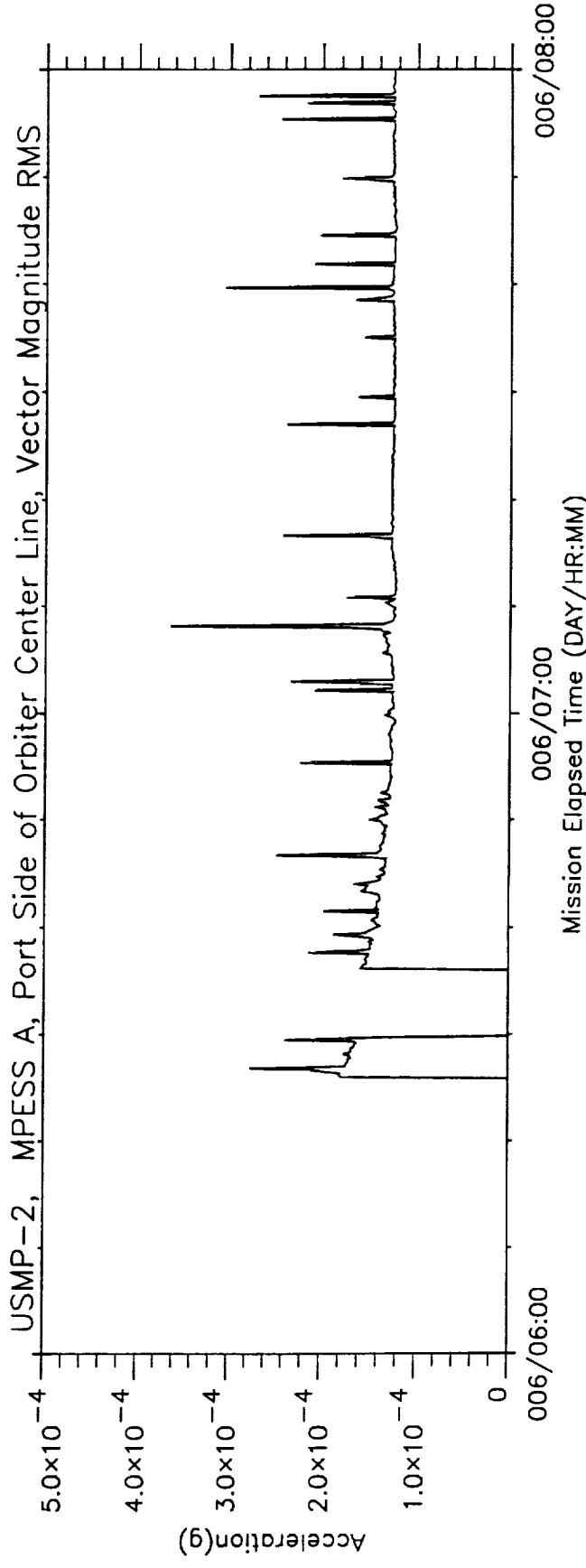
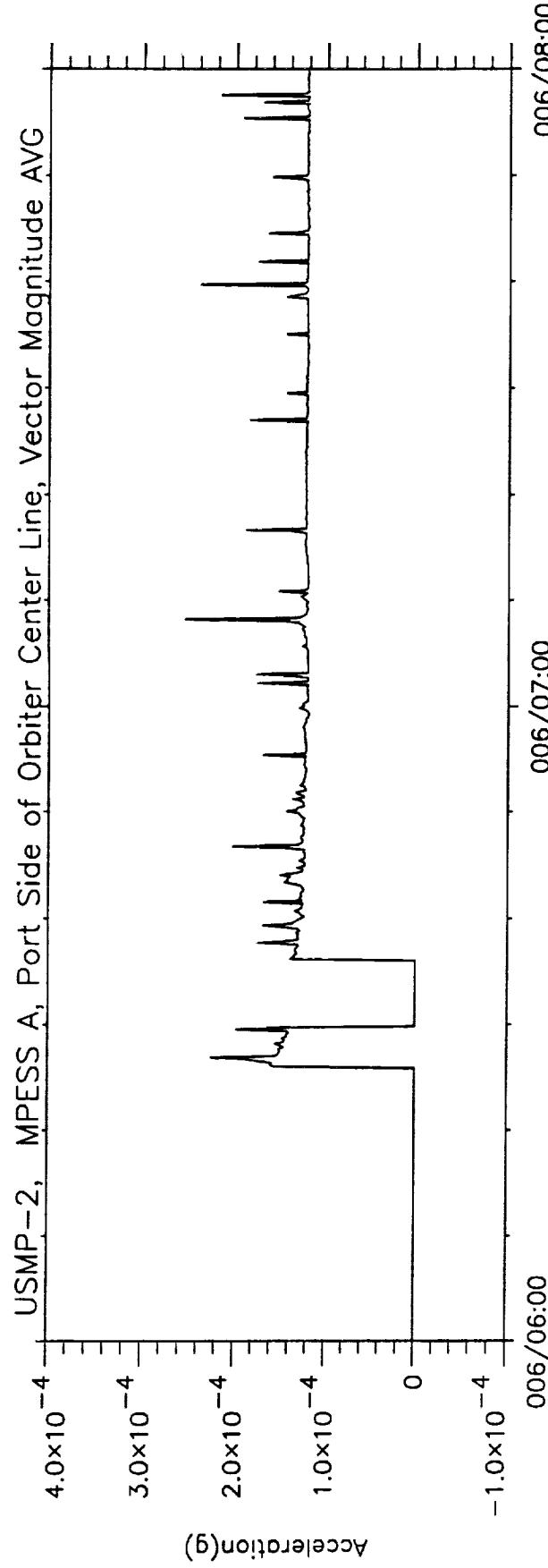
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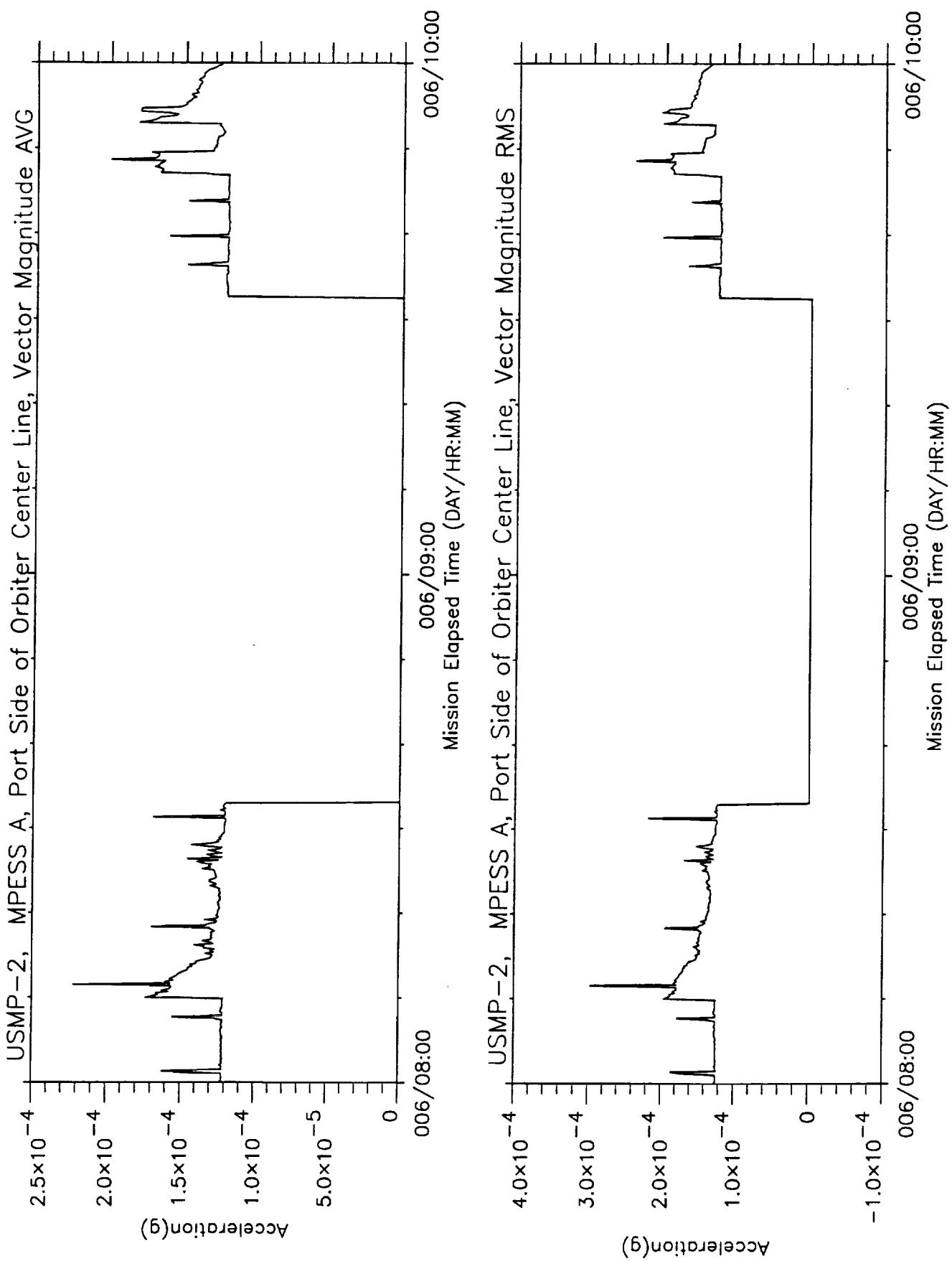
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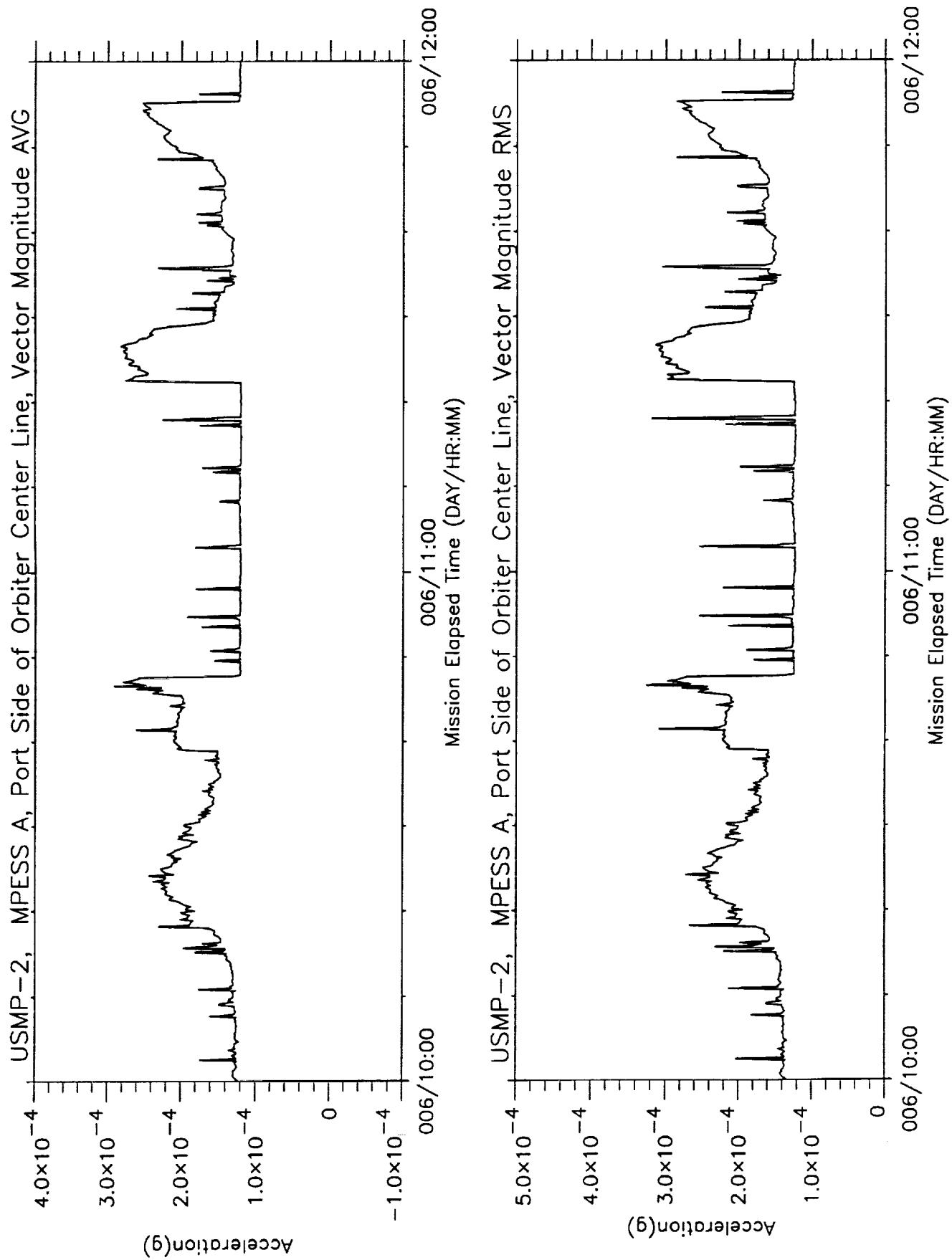
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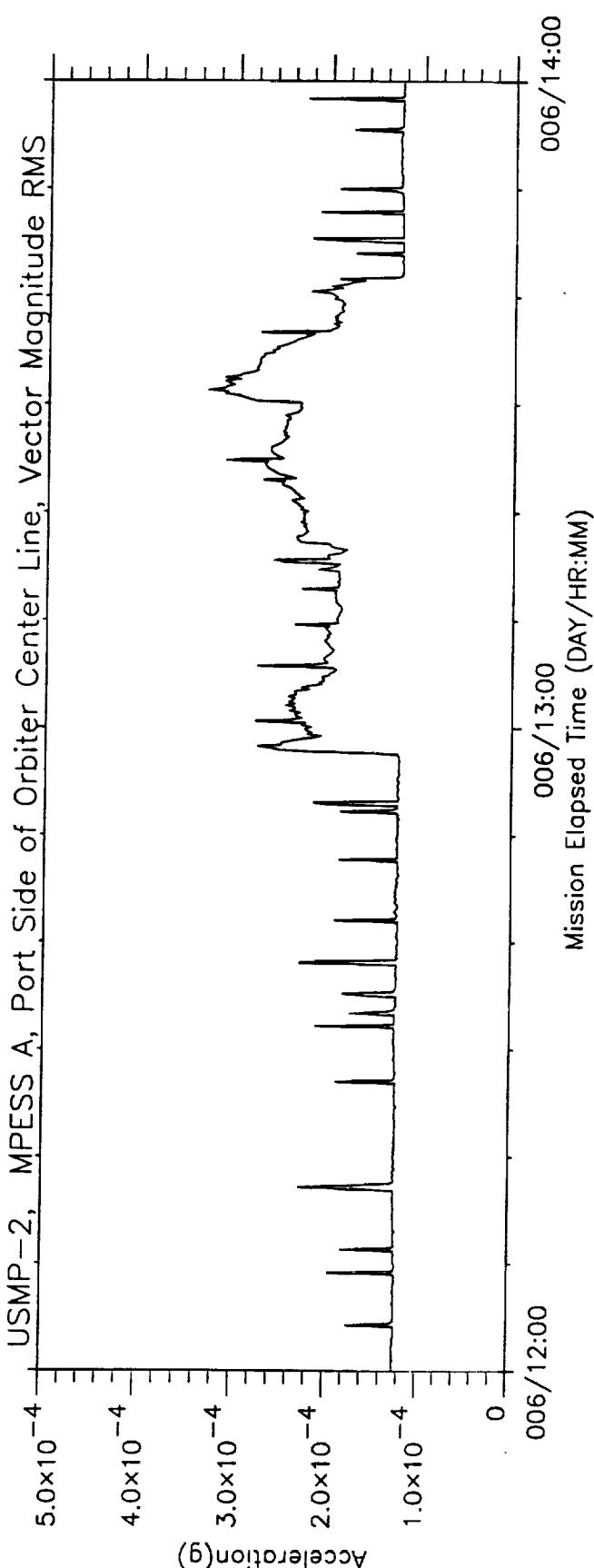
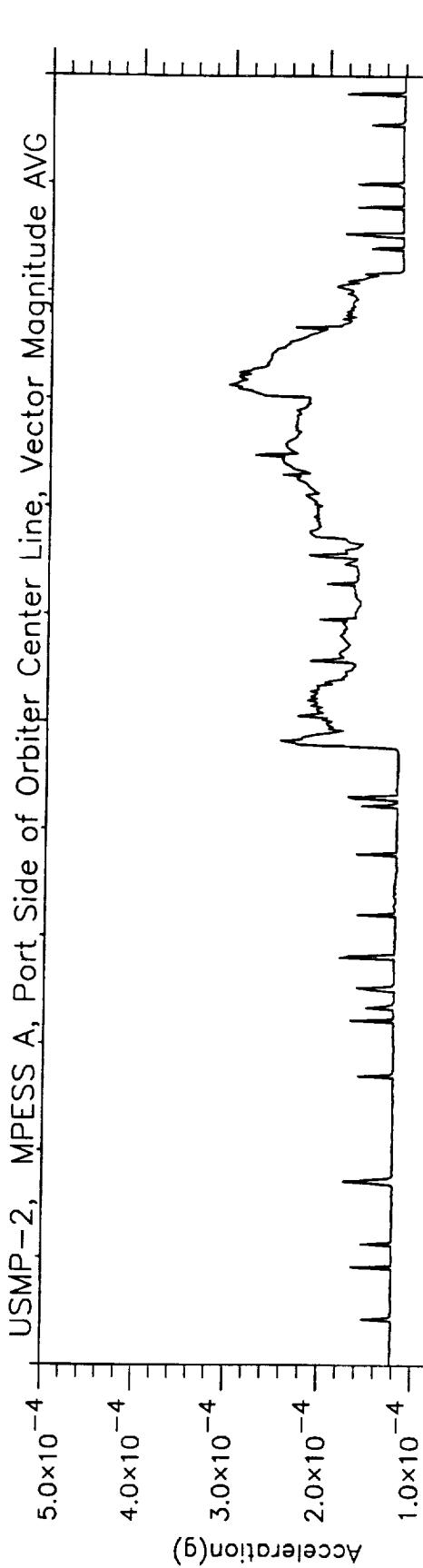
SUMMARY REPORT OF MISSION ACCELERATION MEASUREMENTS FOR STS-62



SUMMARY REPORT OF MISSION ACCELERATION MEASUREMENTS FOR STS-62



SUMMARY REPORT OF MISSION ACCELERATION MEASUREMENTS FOR STS-62

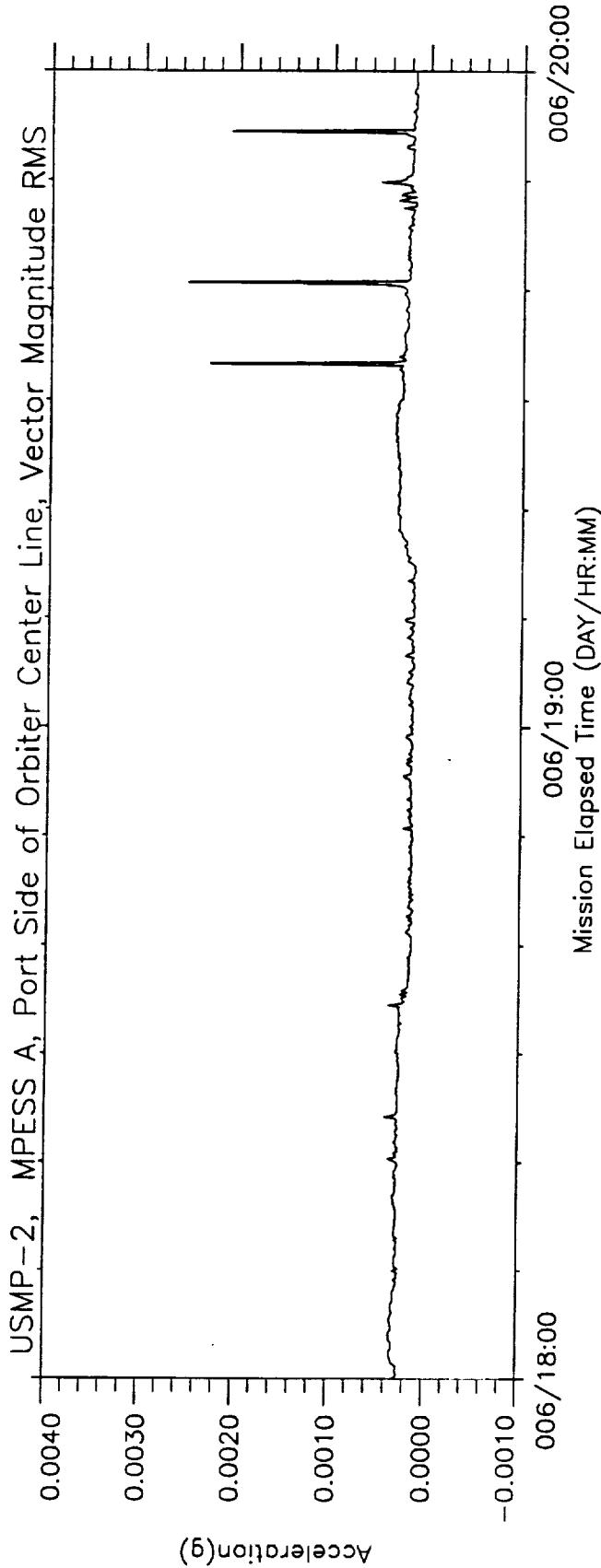
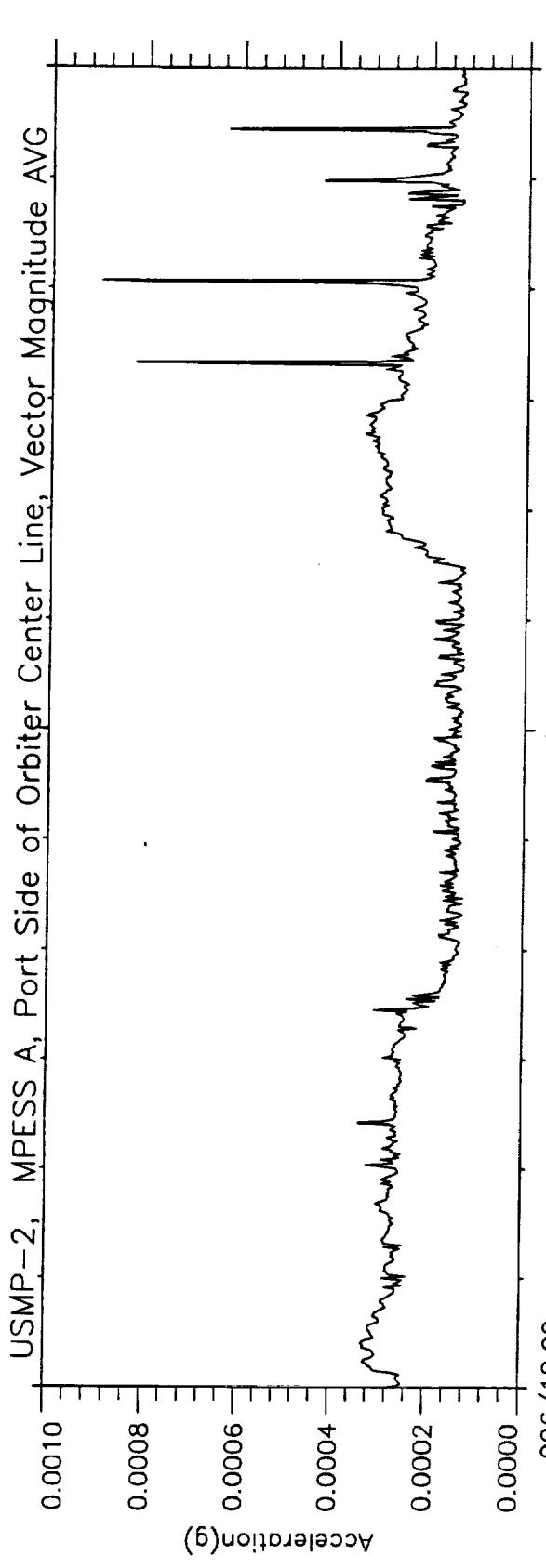


SUMMARY REPORT OF MISSION ACCELERATION MEASUREMENTS FOR STS-62

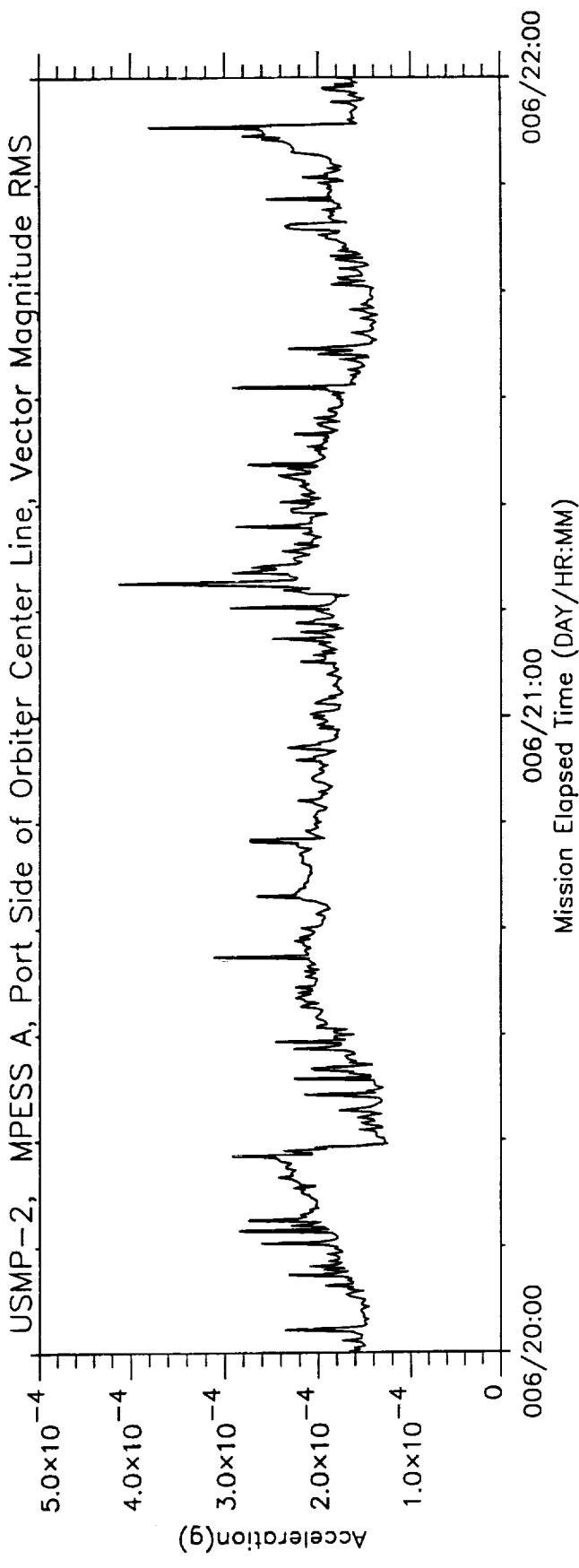
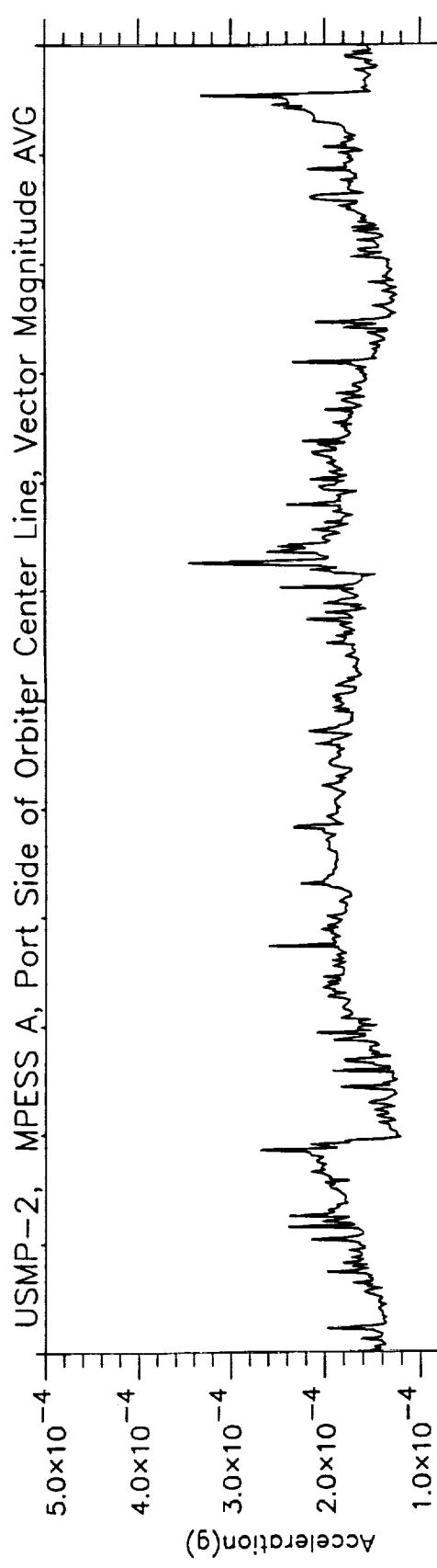
NO DATA AVAILABLE FOR USMP-2, UNIT F, HEAD B

FROM MET 006/14:00:00 - 006/18:00:00

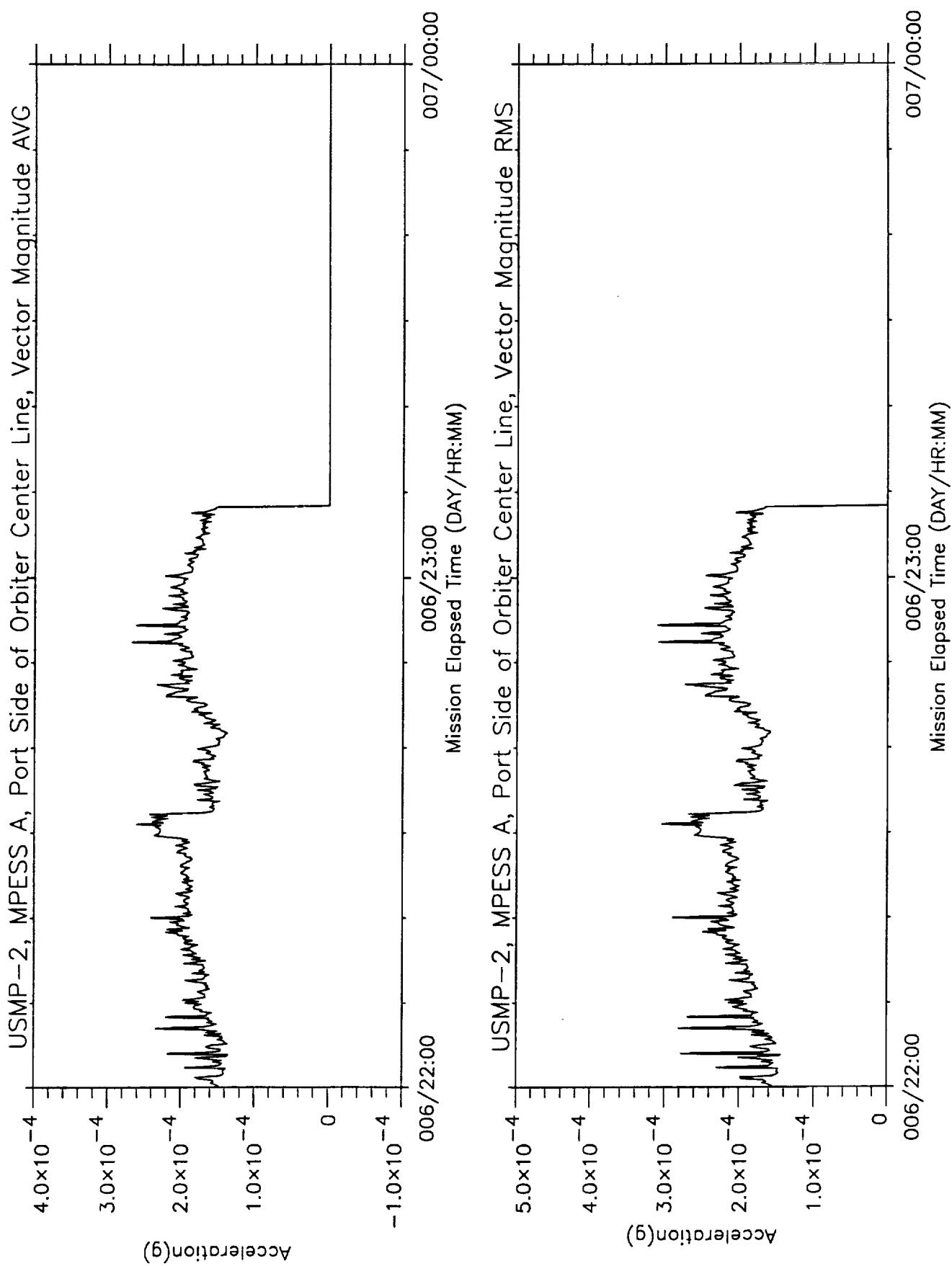
SUMMARY REPORT OF MISSION ACCELERATION MEASUREMENTS FOR STS-62



SUMMARY REPORT OF MISSION ACCELERATION MEASUREMENTS FOR STS-62



SUMMARY REPORT OF MISSION ACCELERATION MEASUREMENTS FOR STS-62

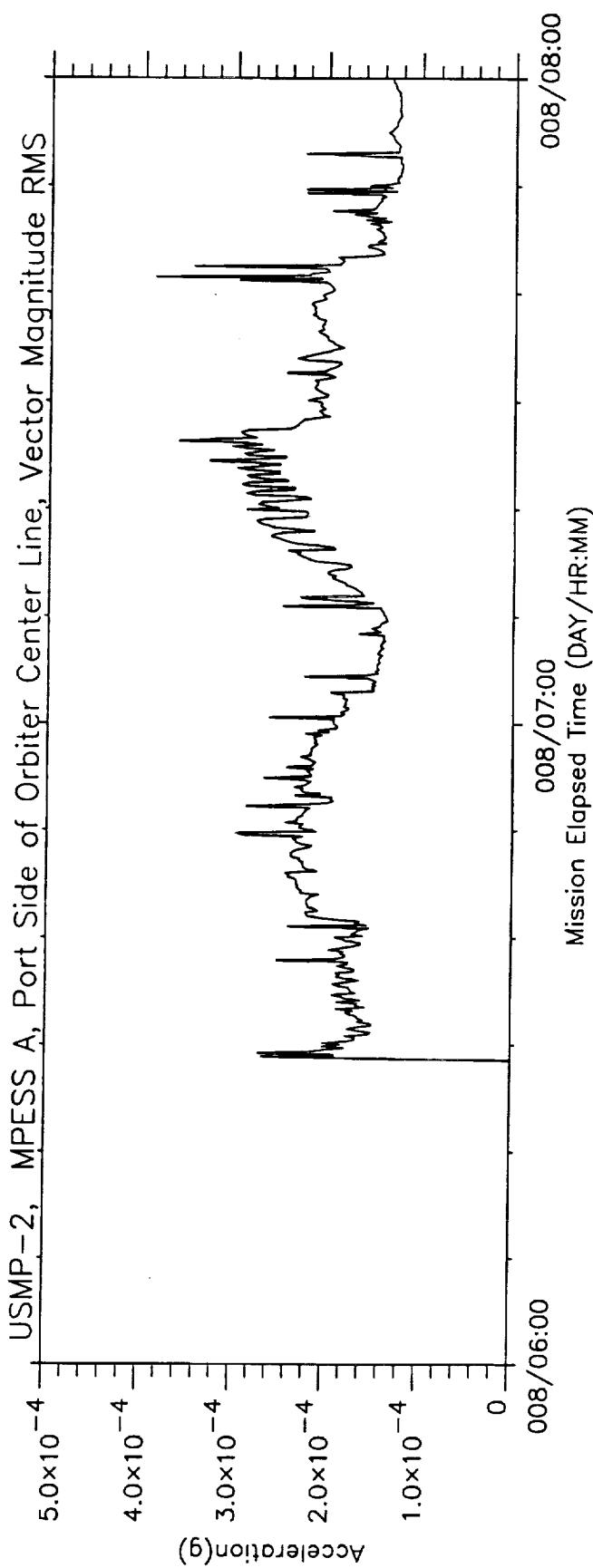
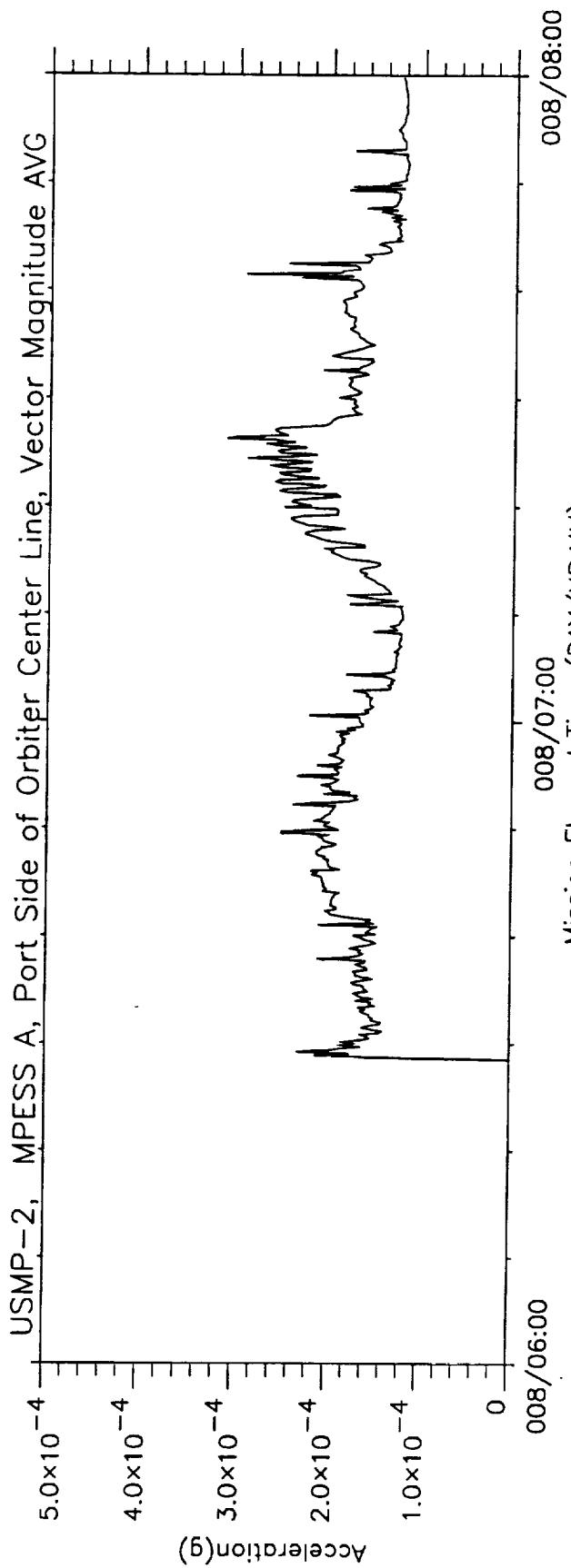


SUMMARY REPORT OF MISSION ACCELERATION MEASUREMENTS FOR STS-62

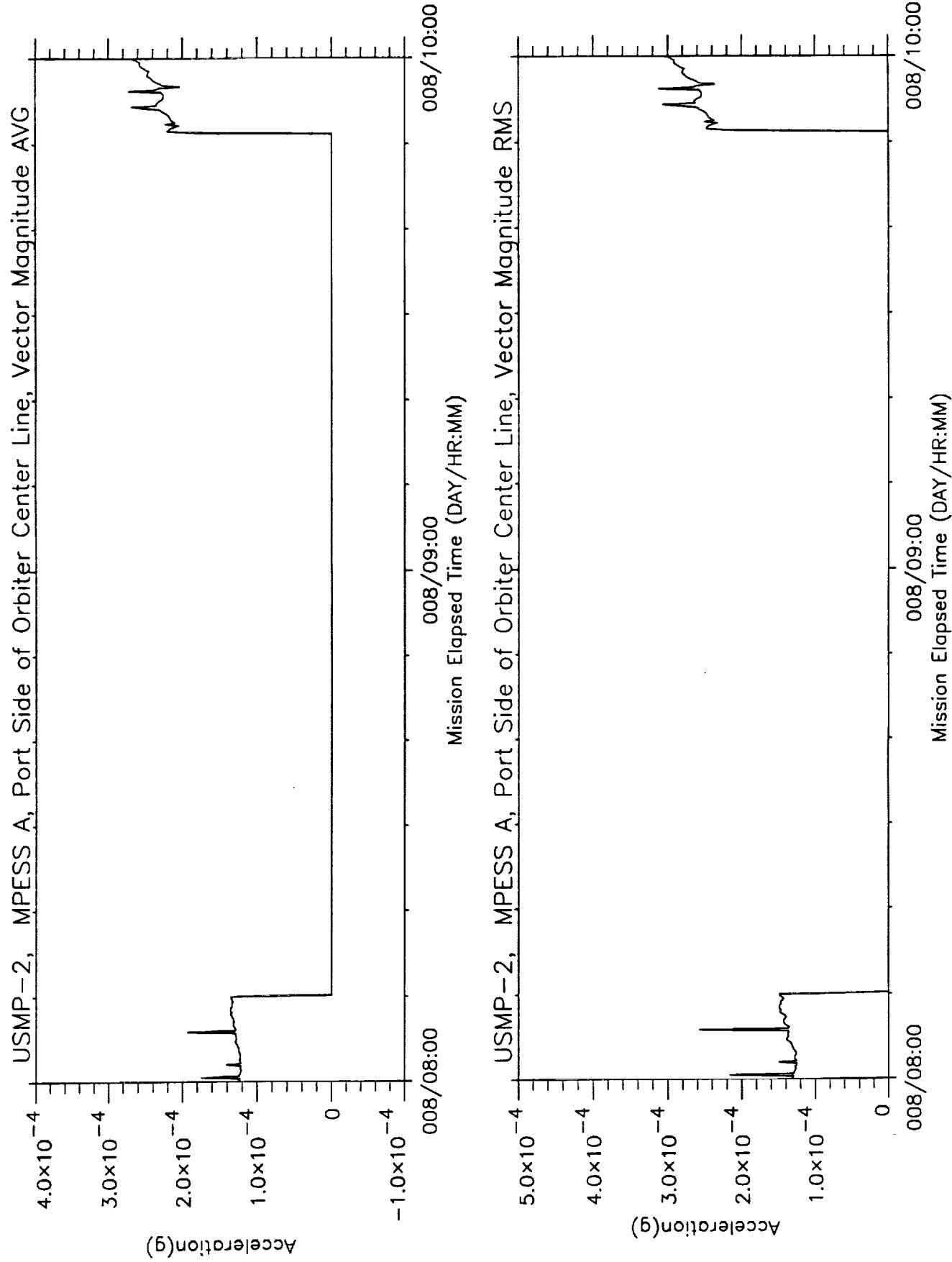
NO DATA AVAILABLE FOR USMP-2, UNIT F, HEAD B

FROM MET 006/23:08:00 - 008/06:28:00

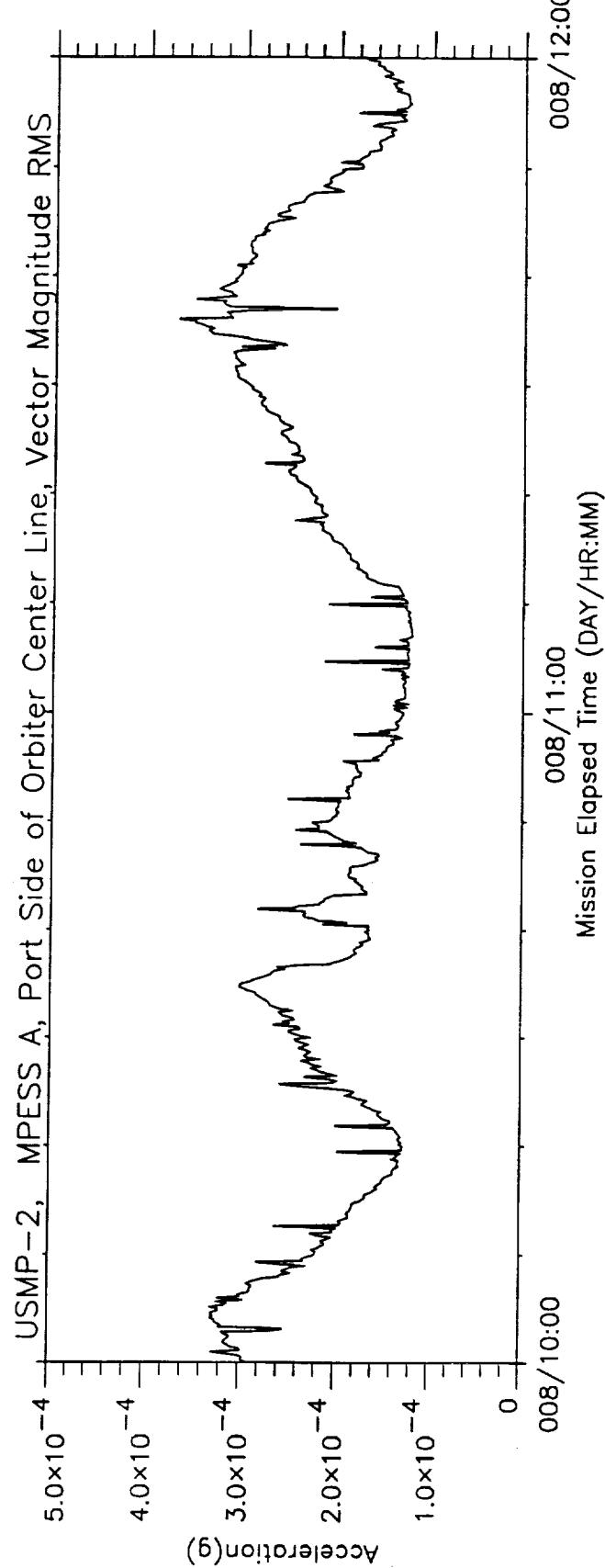
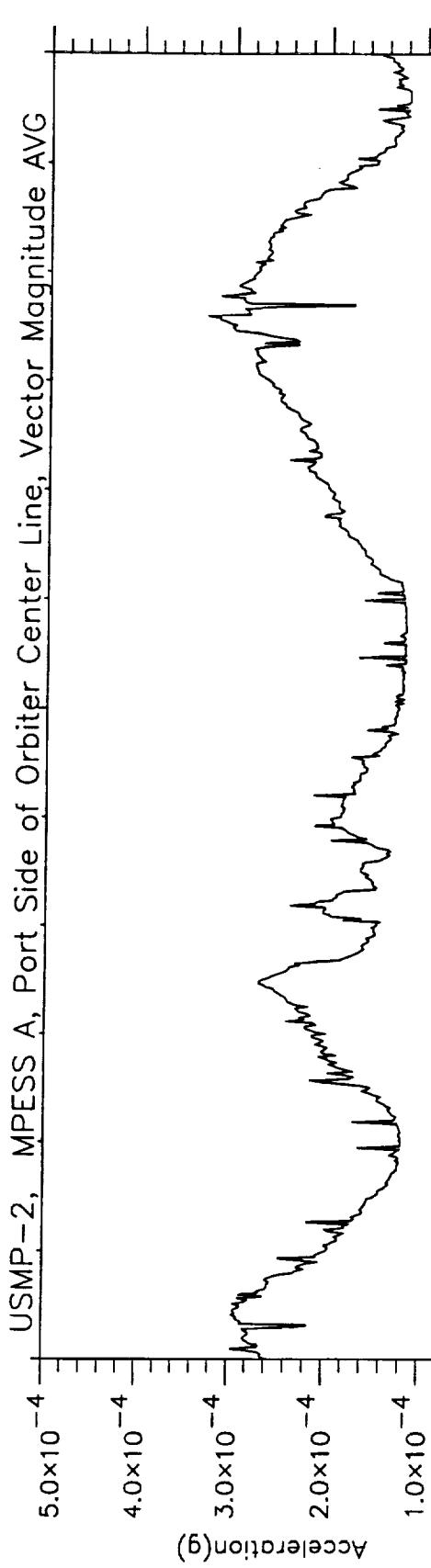
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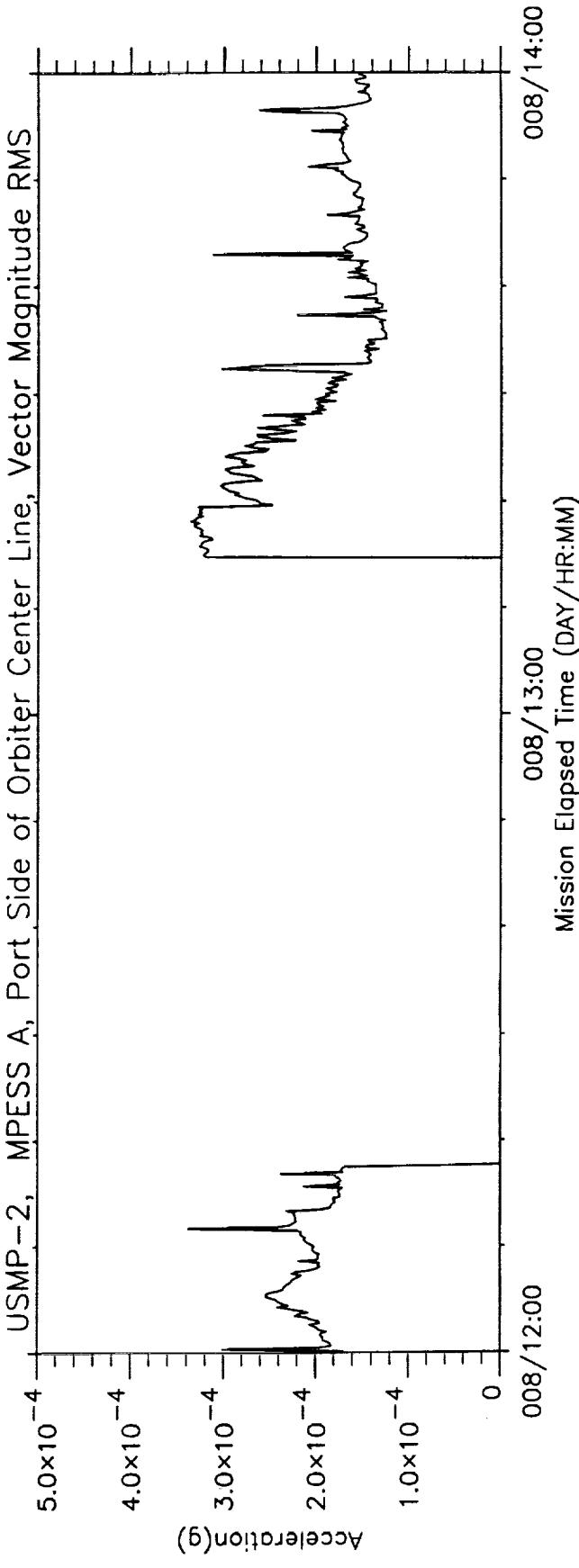
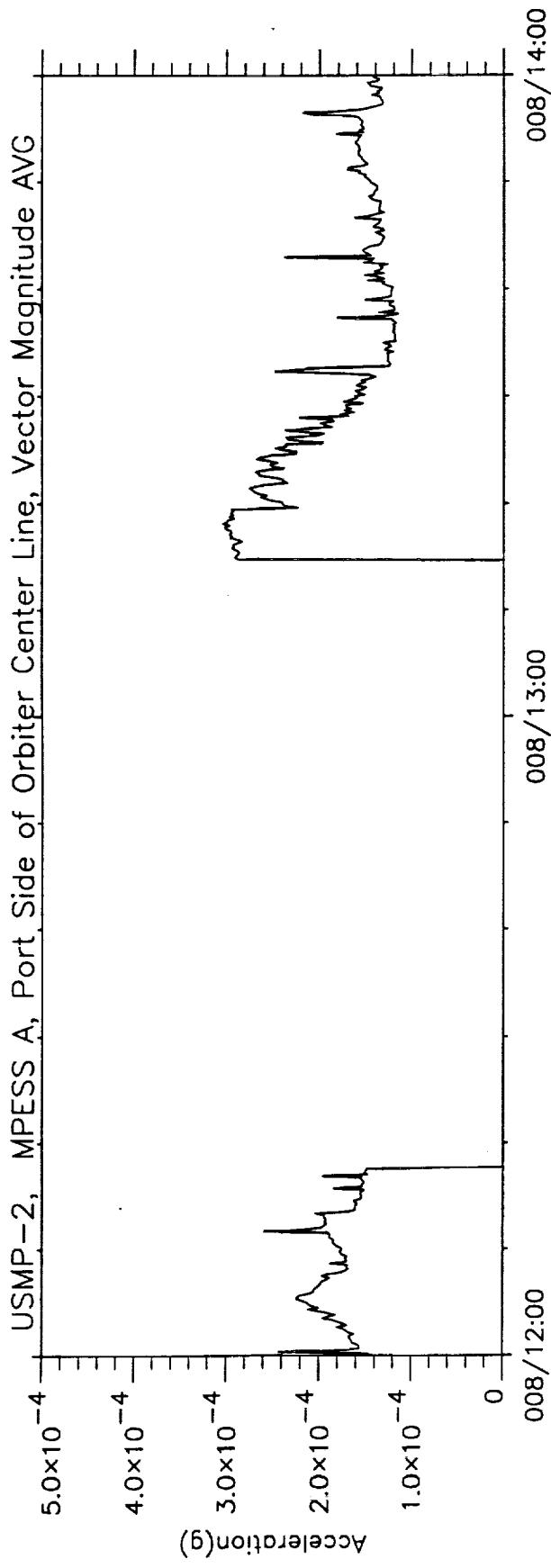
SUMMARY REPORT OF MISSION ACCELERATION MEASUREMENTS FOR STS-62



SUMMARY REPORT OF MISSION ACCELERATION MEASUREMENTS FOR STS-62



SUMMARY REPORT OF MISSION ACCELERATION MEASUREMENTS FOR STS-62

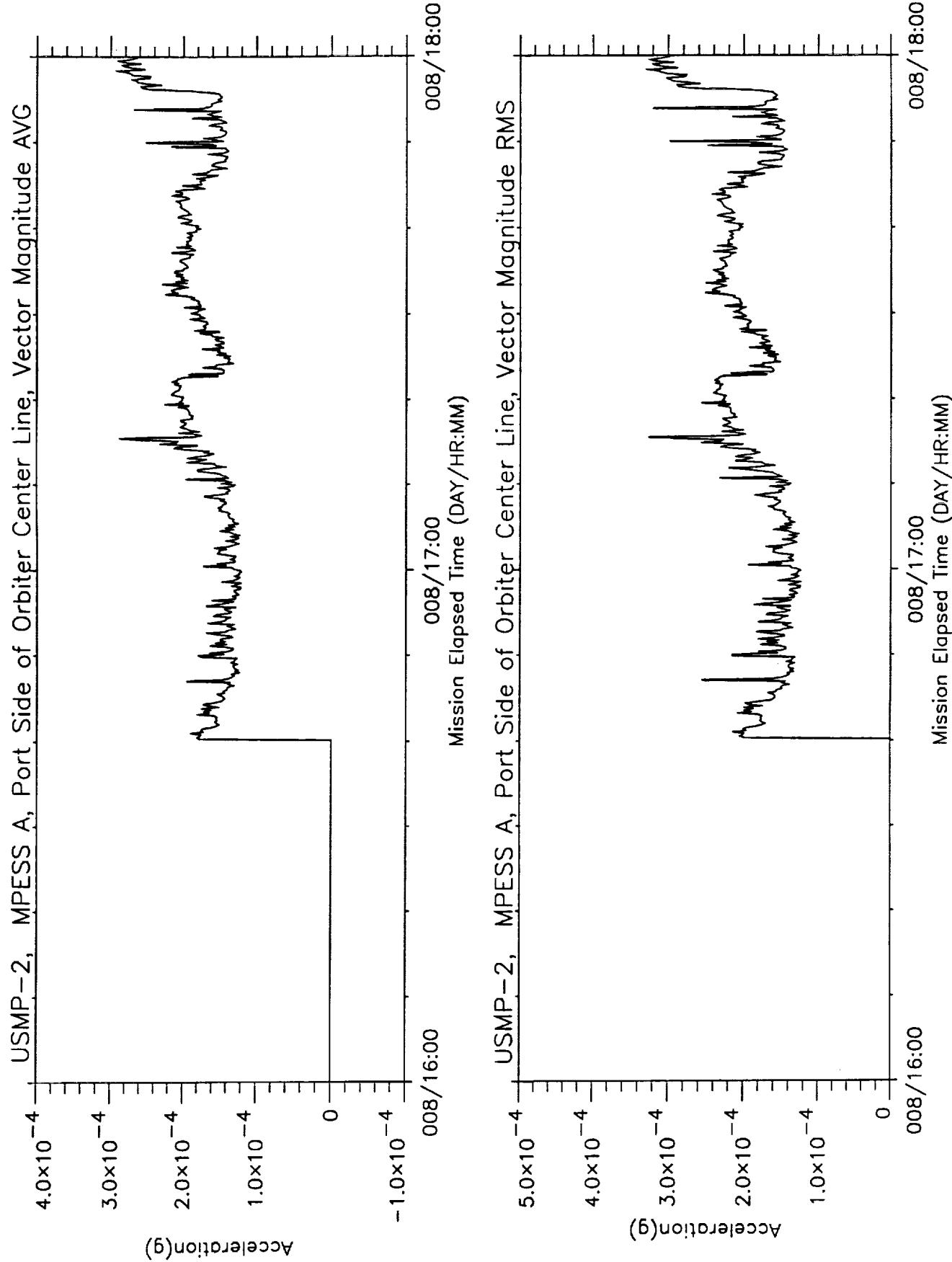


SUMMARY REPORT OF MISSION ACCELERATION MEASUREMENTS FOR STS-62

NO DATA AVAILABLE FOR USMP-2, UNIT F, HEAD B

FROM MET 008/14:00:00 - 008/16:40:00

SUMMARY REPORT OF MISSION ACCELERATION MEASUREMENTS FOR STS-62

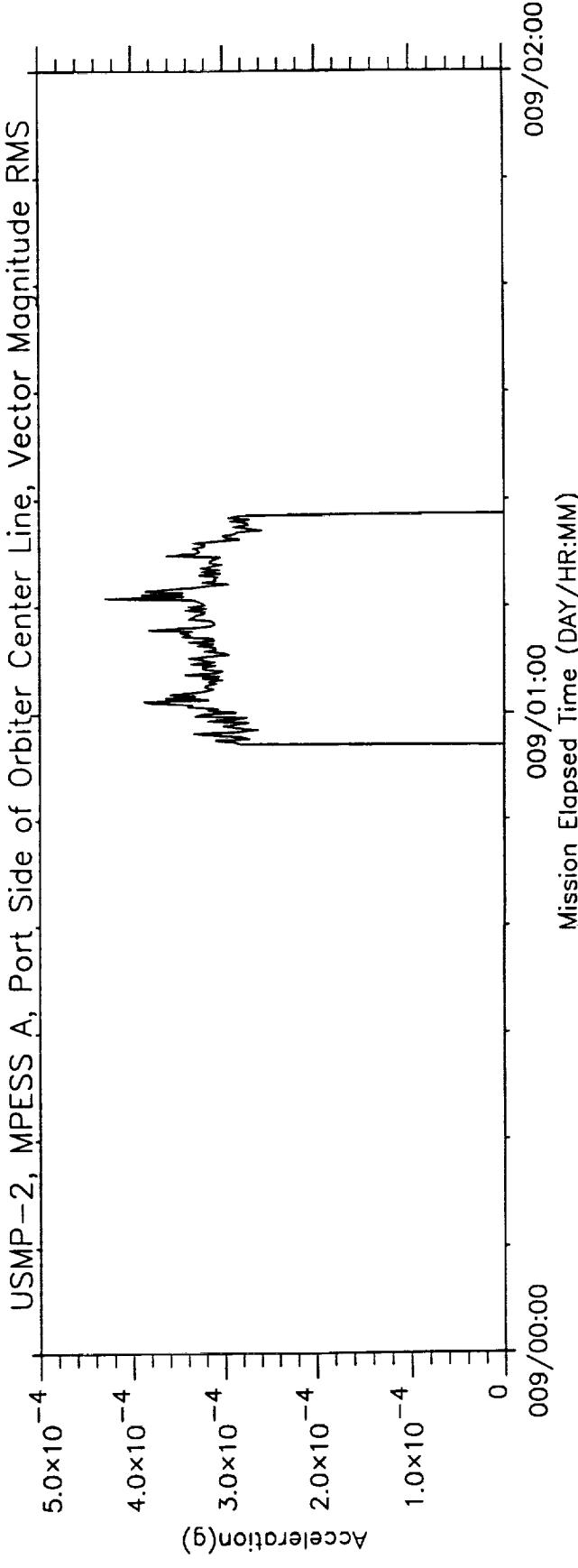
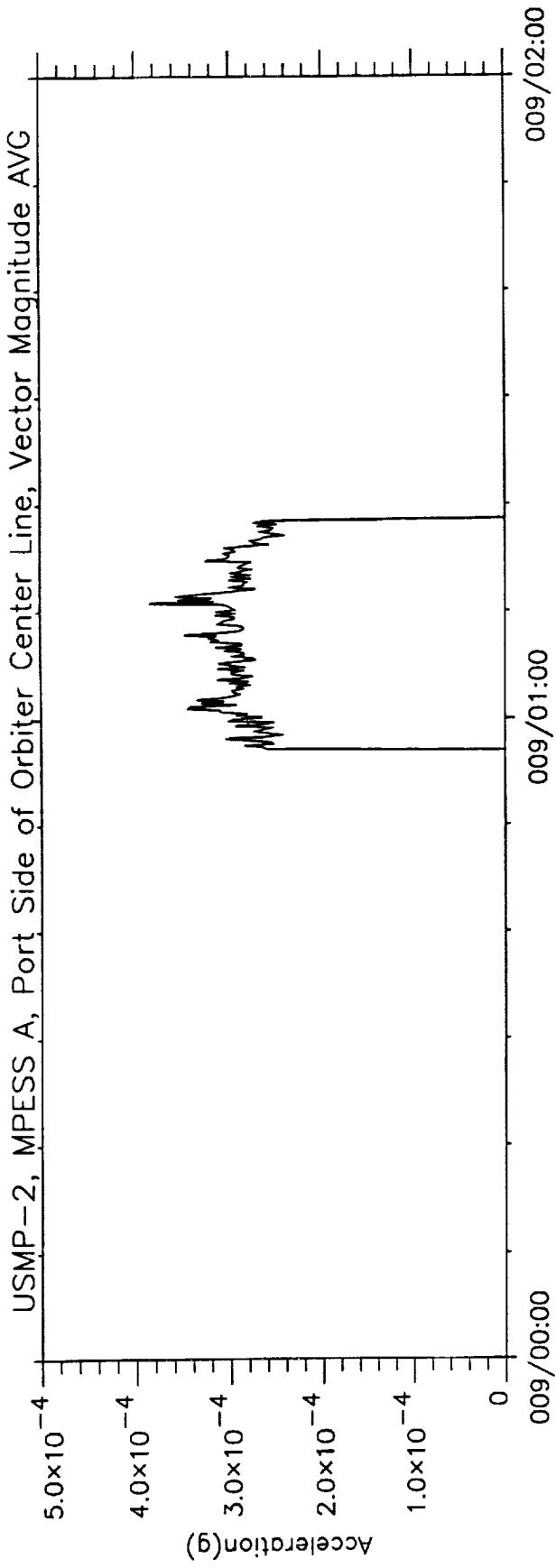


SUMMARY REPORT OF MISSION ACCELERATION MEASUREMENTS FOR STS-62

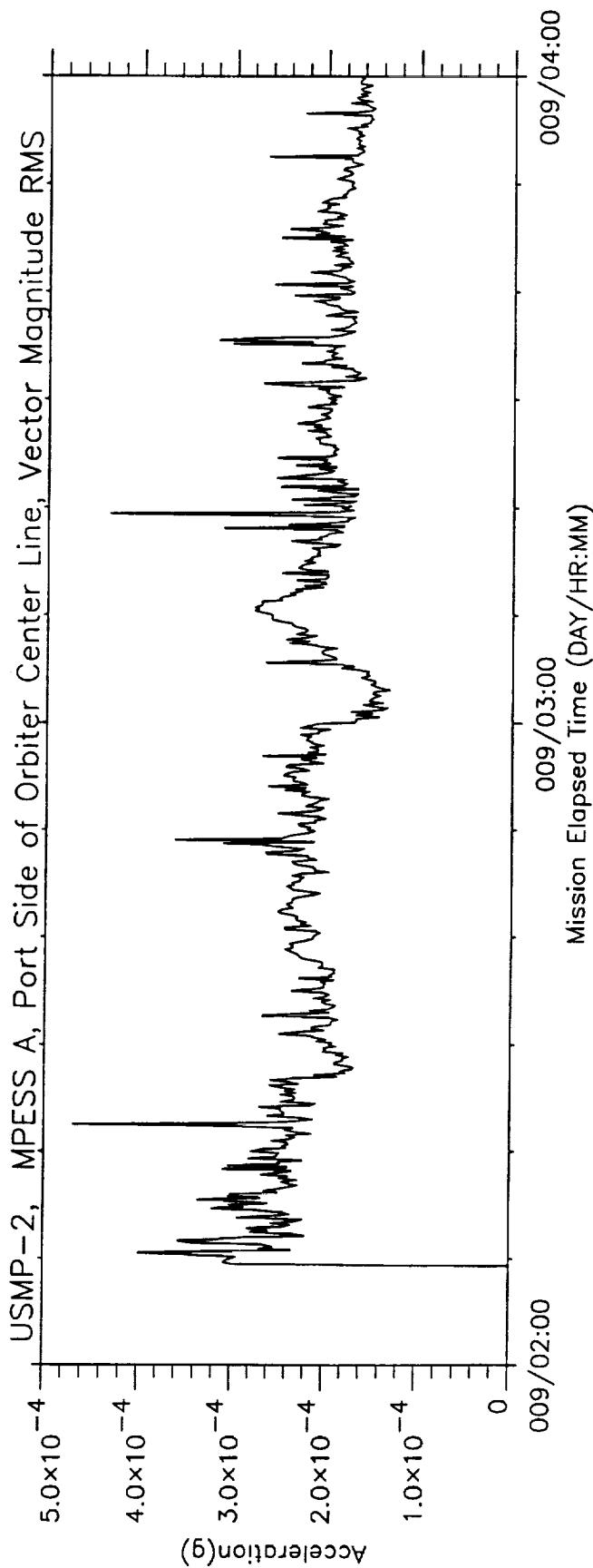
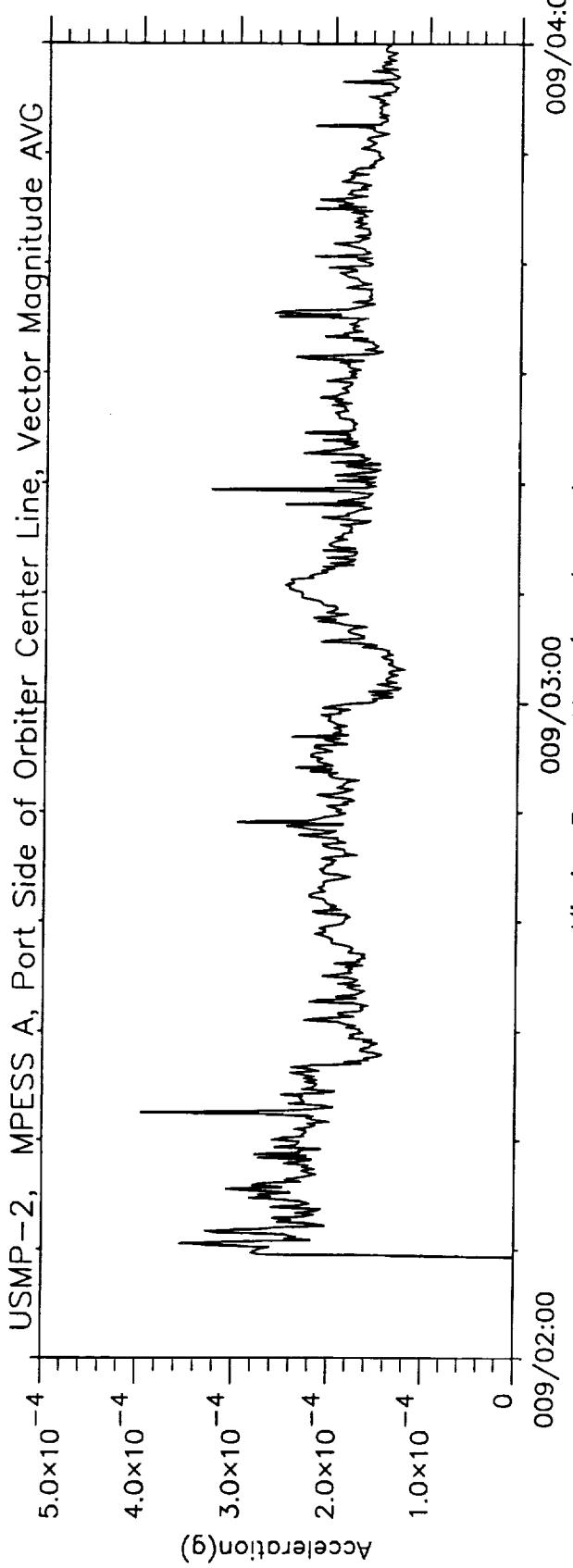
NO DATA AVAILABLE FOR USMP-2, UNIT F, HEAD B

FROM MET 008/18:00:00 - 009/00:57:00

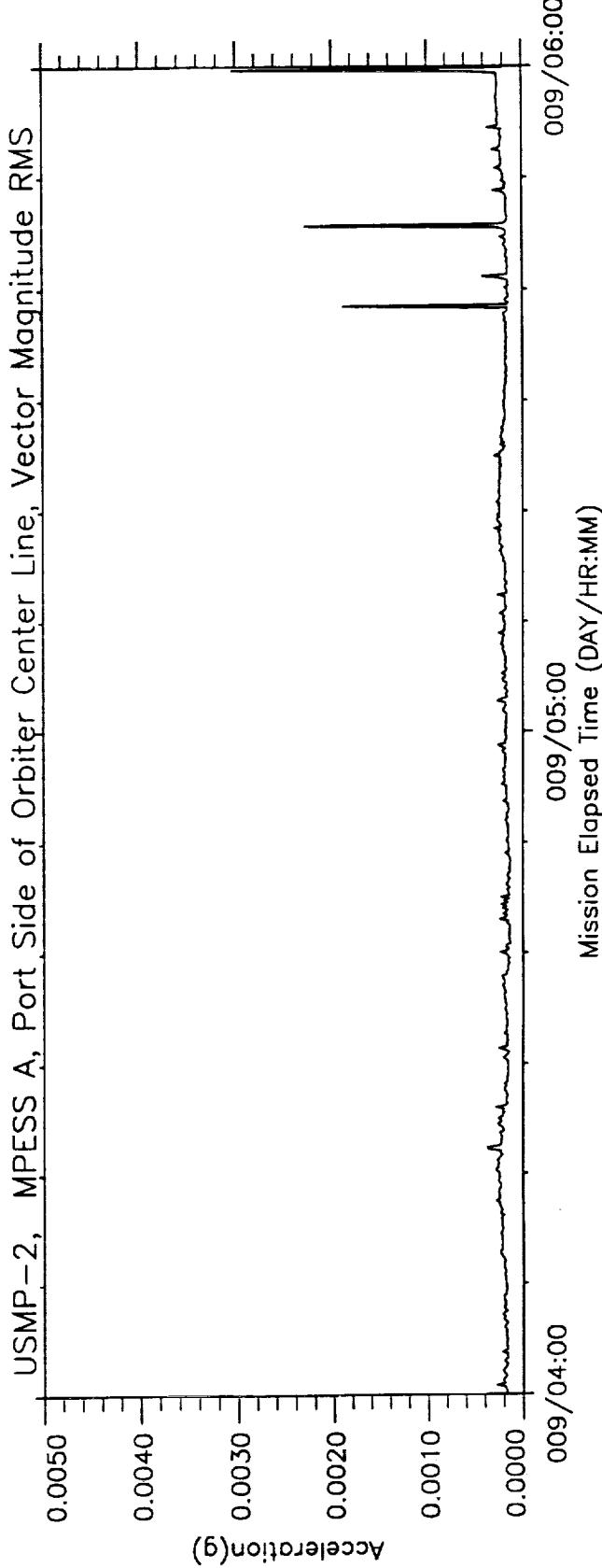
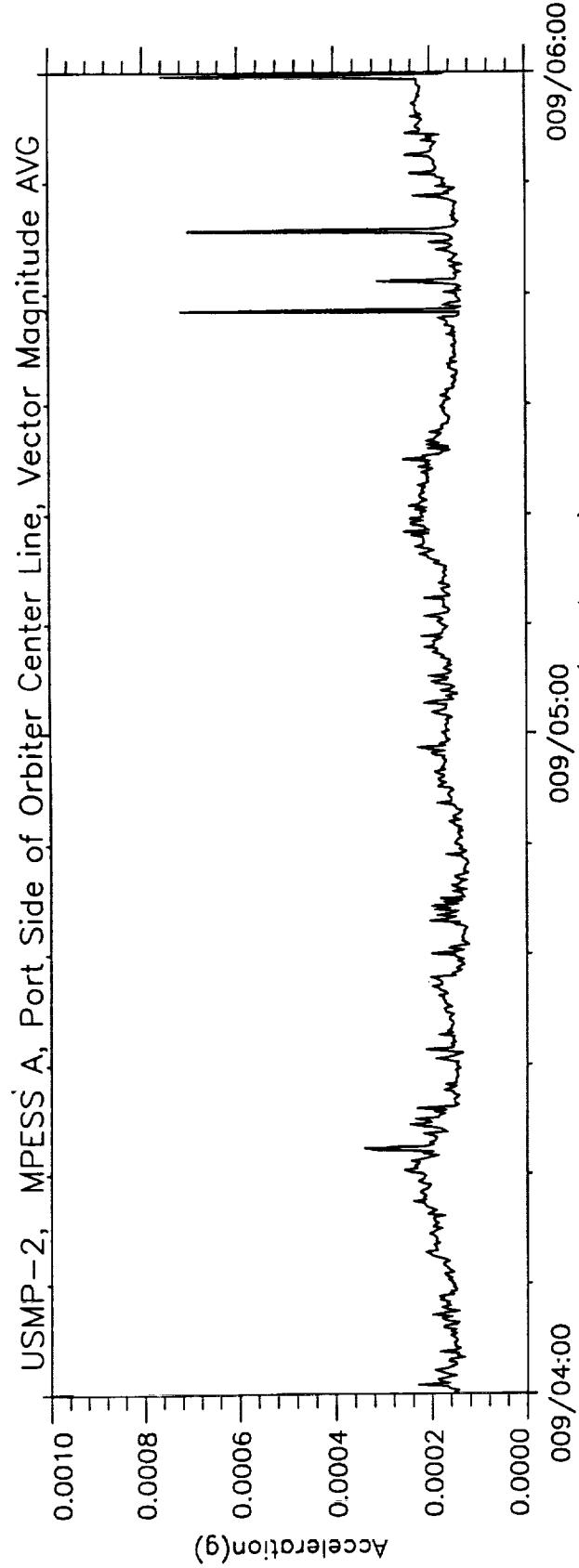
SUMMARY REPORT OF MISSION ACCELERATION MEASUREMENTS FOR STS-62



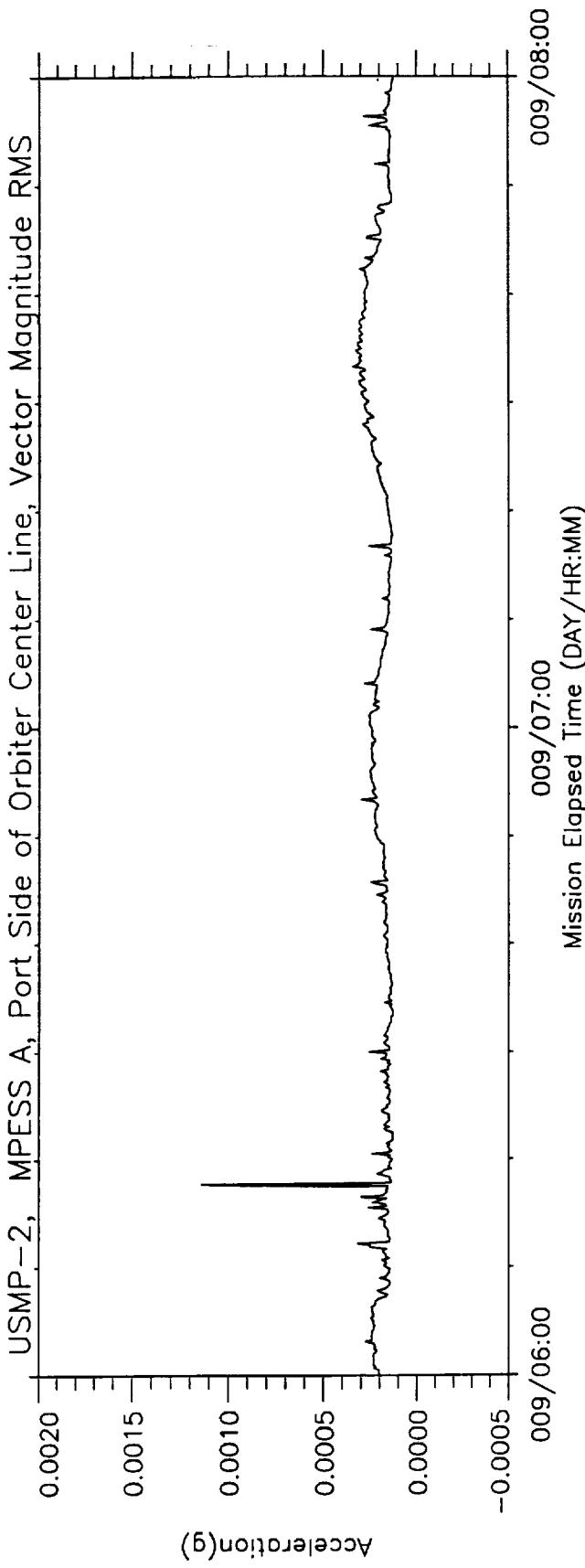
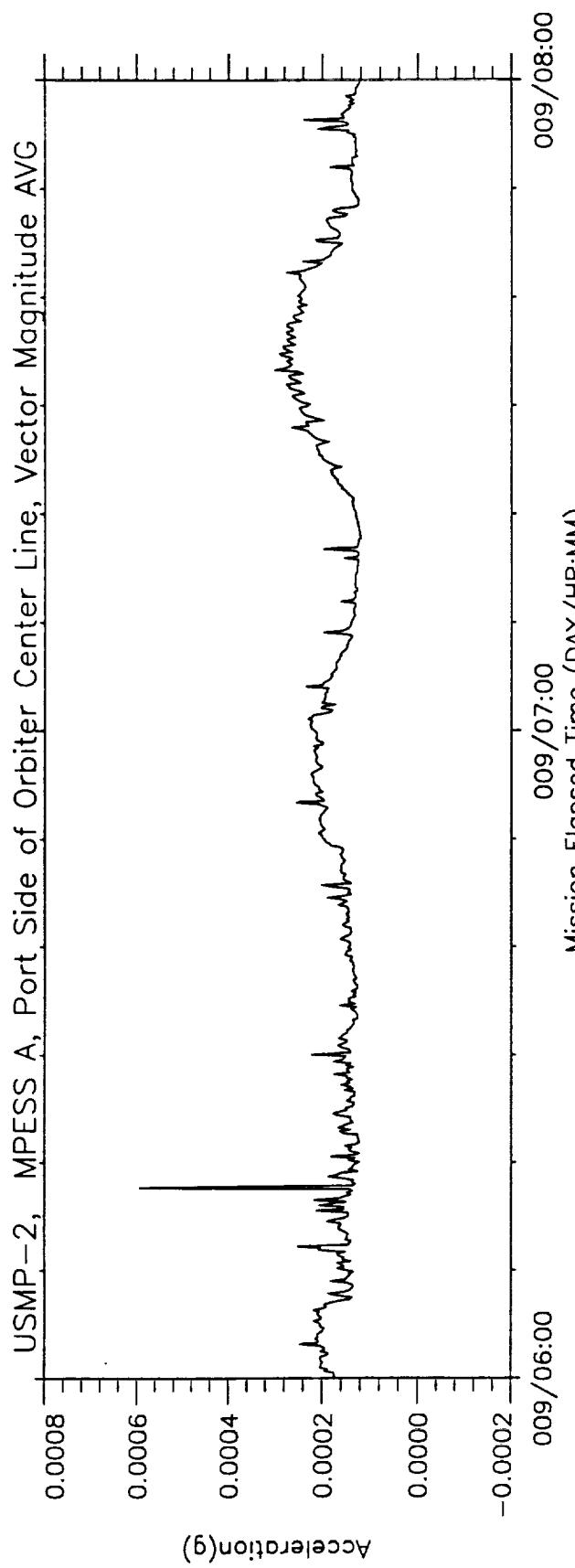
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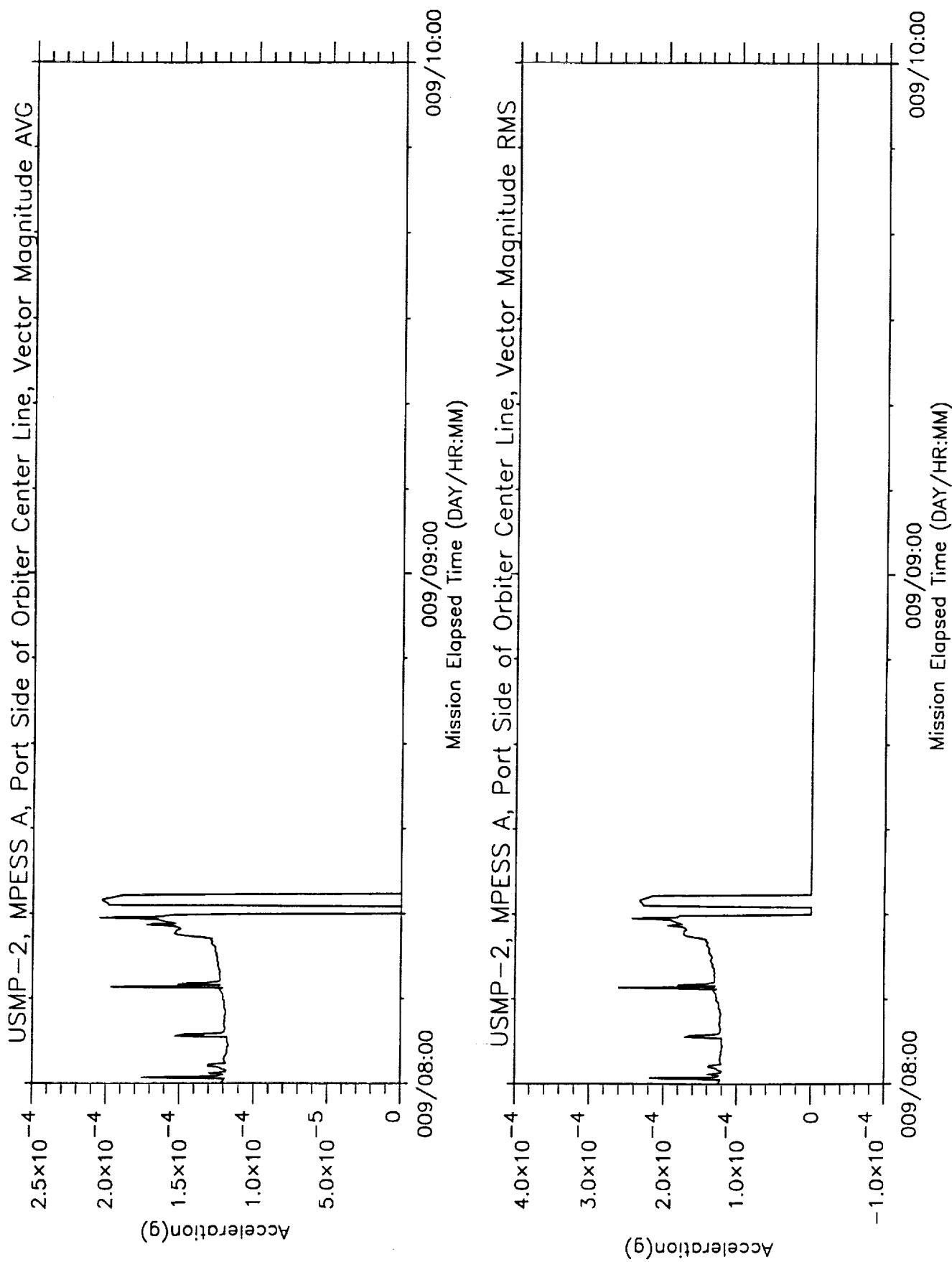
SUMMARY REPORT OF MISSION ACCELERATION MEASUREMENTS FOR STS-62



SUMMARY REPORT OF MISSION ACCELERATION MEASUREMENTS FOR STS-62



SUMMARY REPORT OF MISSION ACCELERATION MEASUREMENTS FOR STS-62

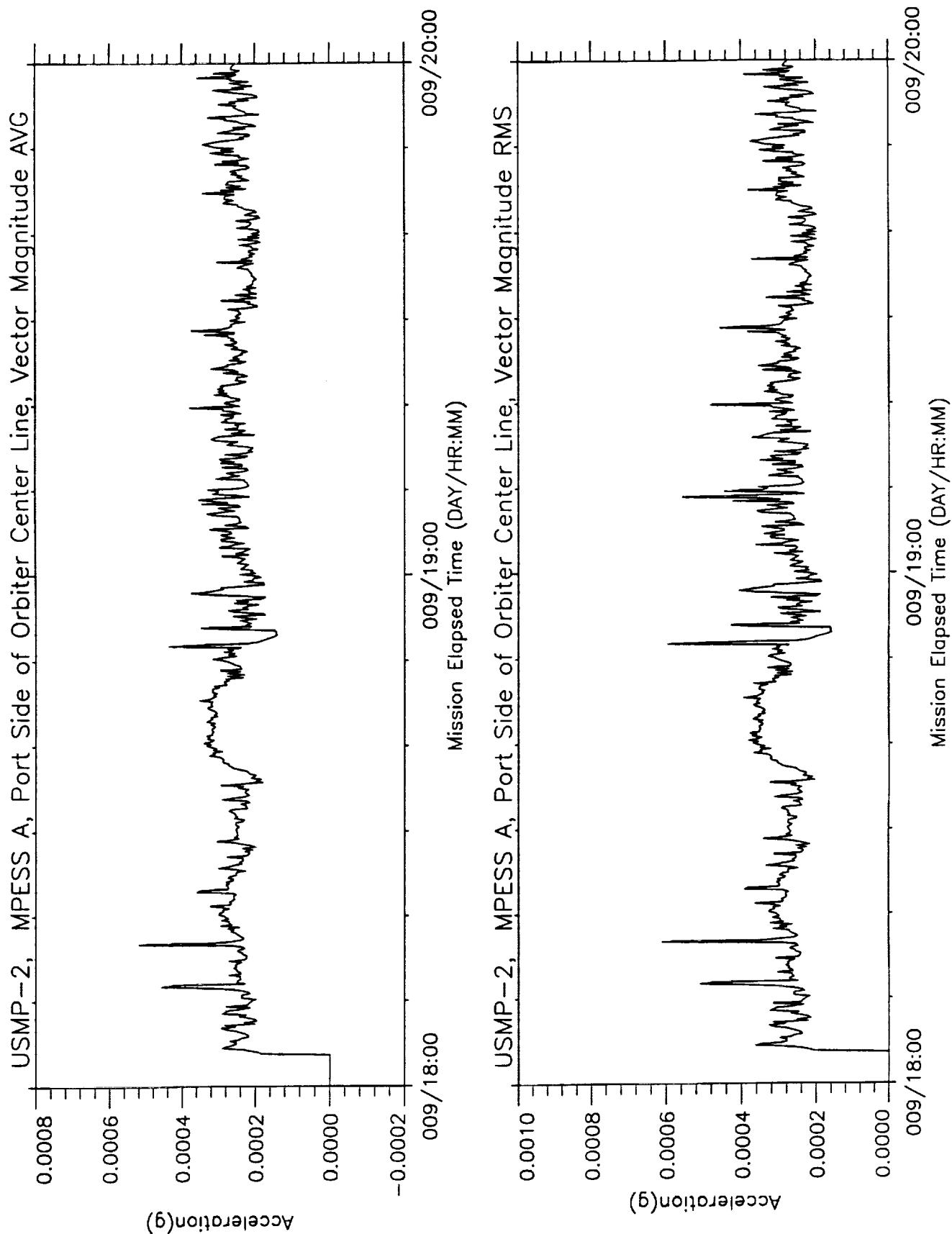


SUMMARY REPORT OF MISSION ACCELERATION MEASUREMENTS FOR STS-62

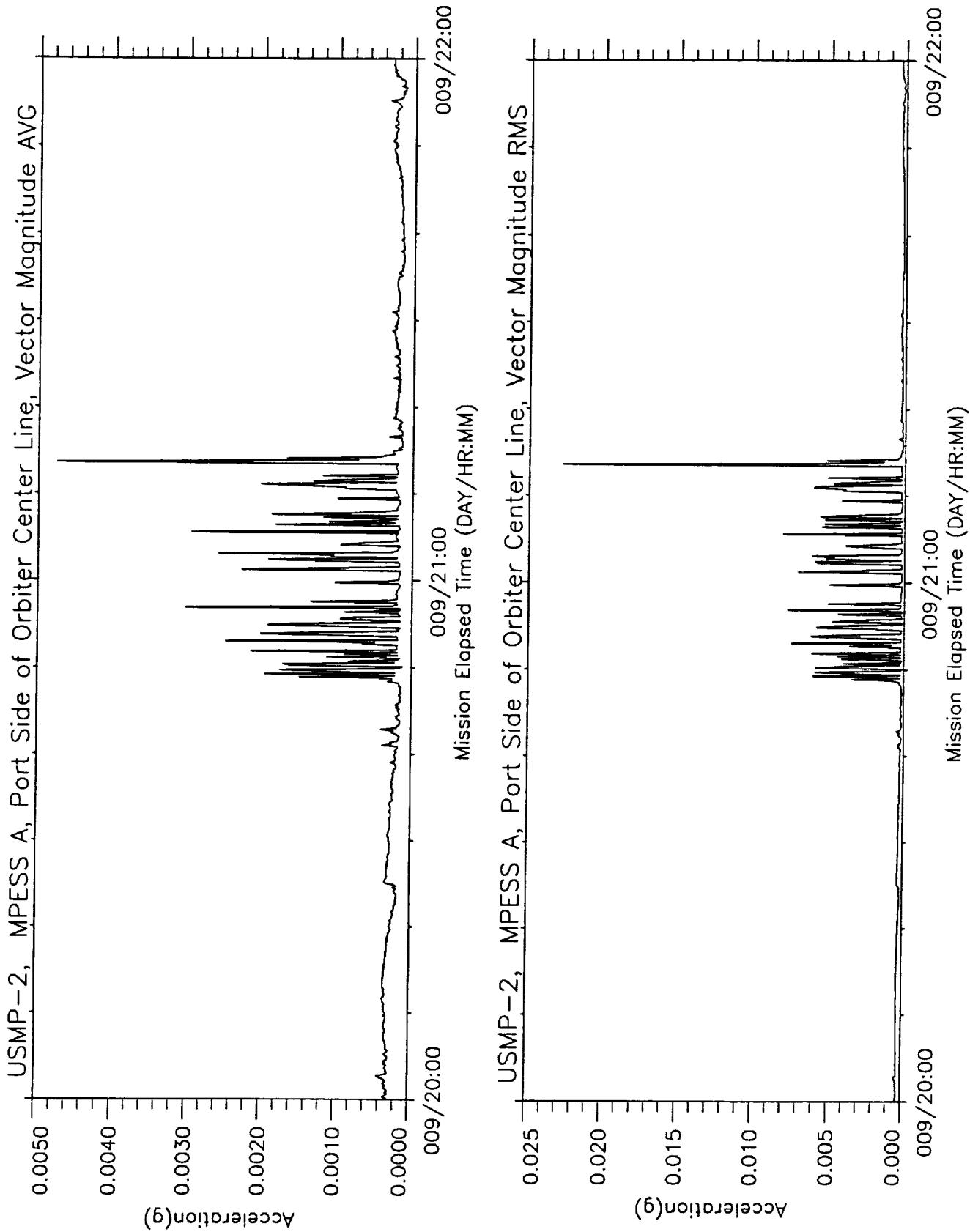
NO DATA AVAILABLE FOR USMP-2, UNIT F, HEAD B

FROM MET 009/08:22:00 - 009/18:04:00

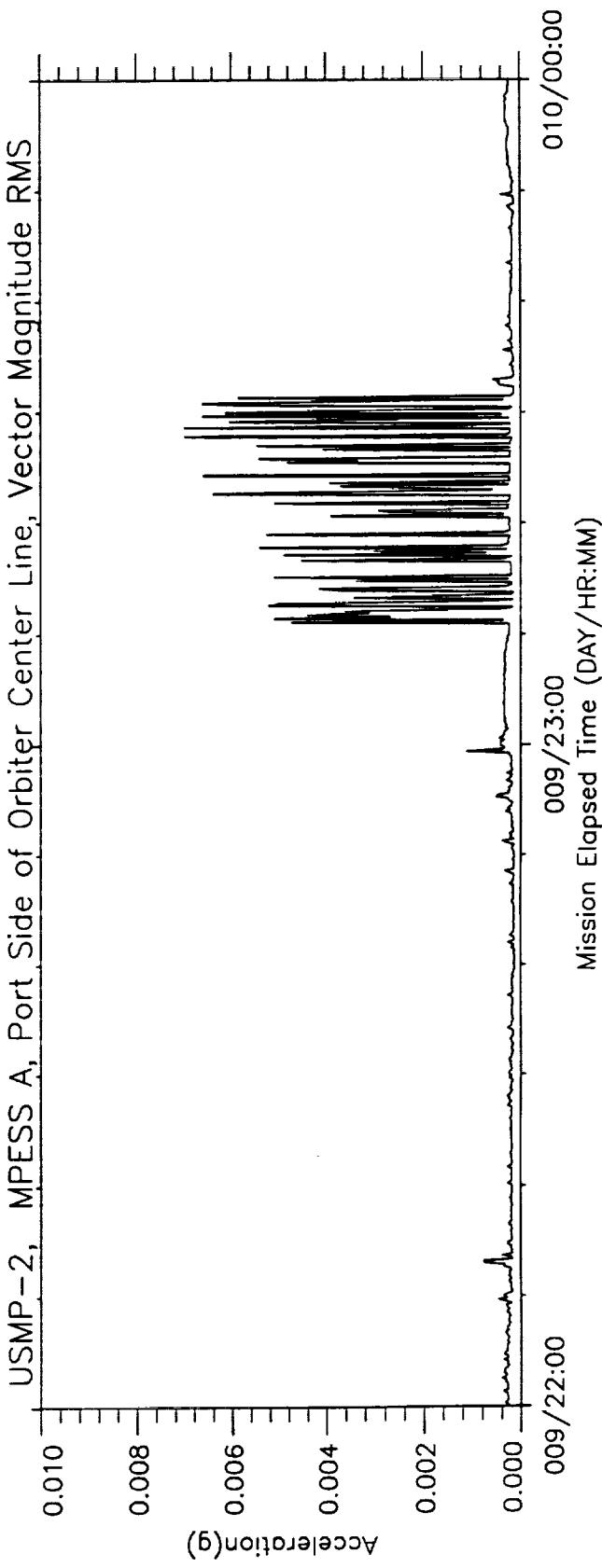
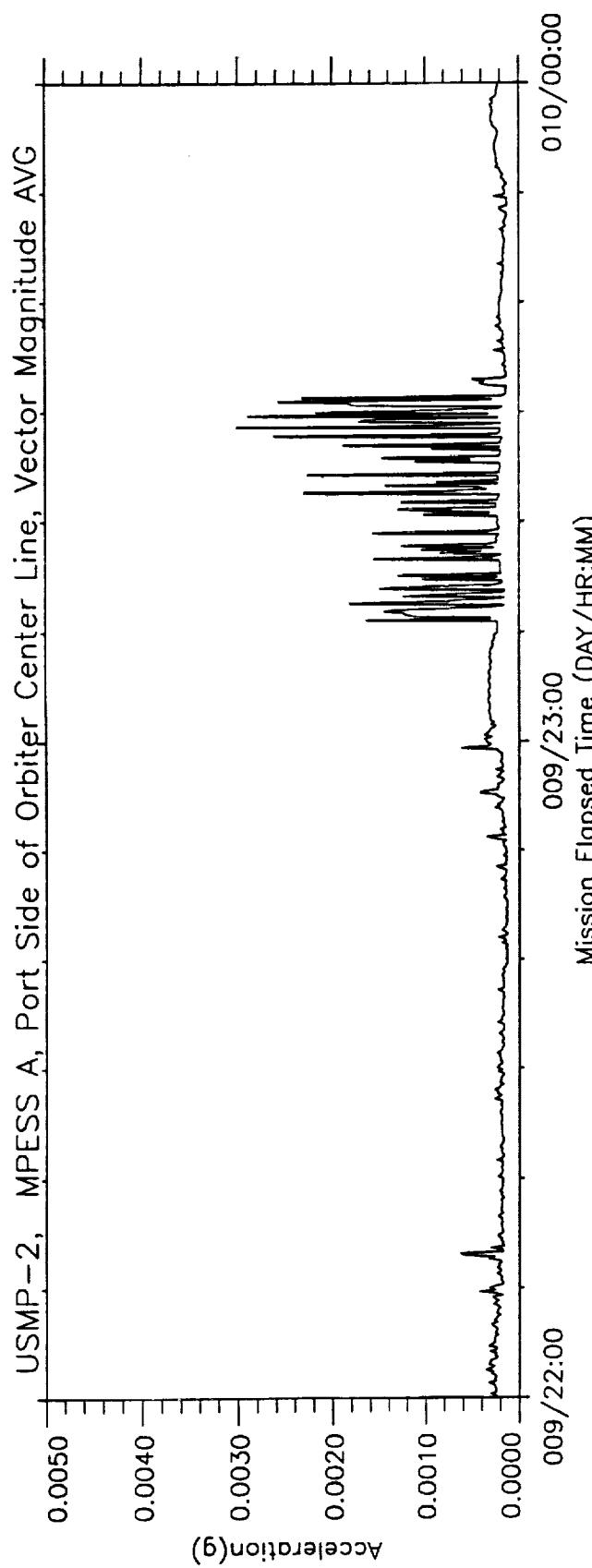
SUMMARY REPORT OF MISSION ACCELERATION MEASUREMENTS FOR STS-62



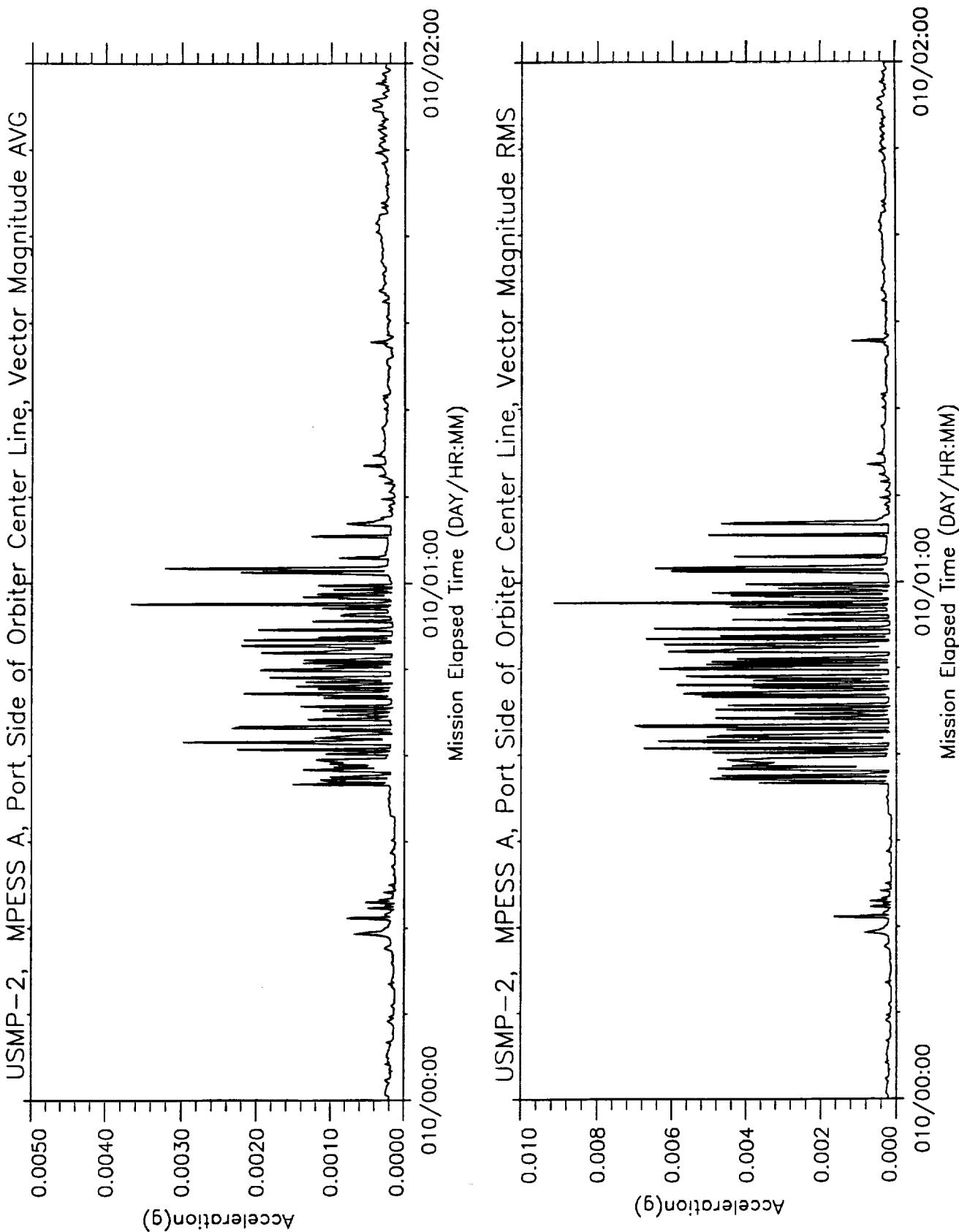
SUMMARY REPORT OF MISSION ACCELERATION MEASUREMENTS FOR STS-62



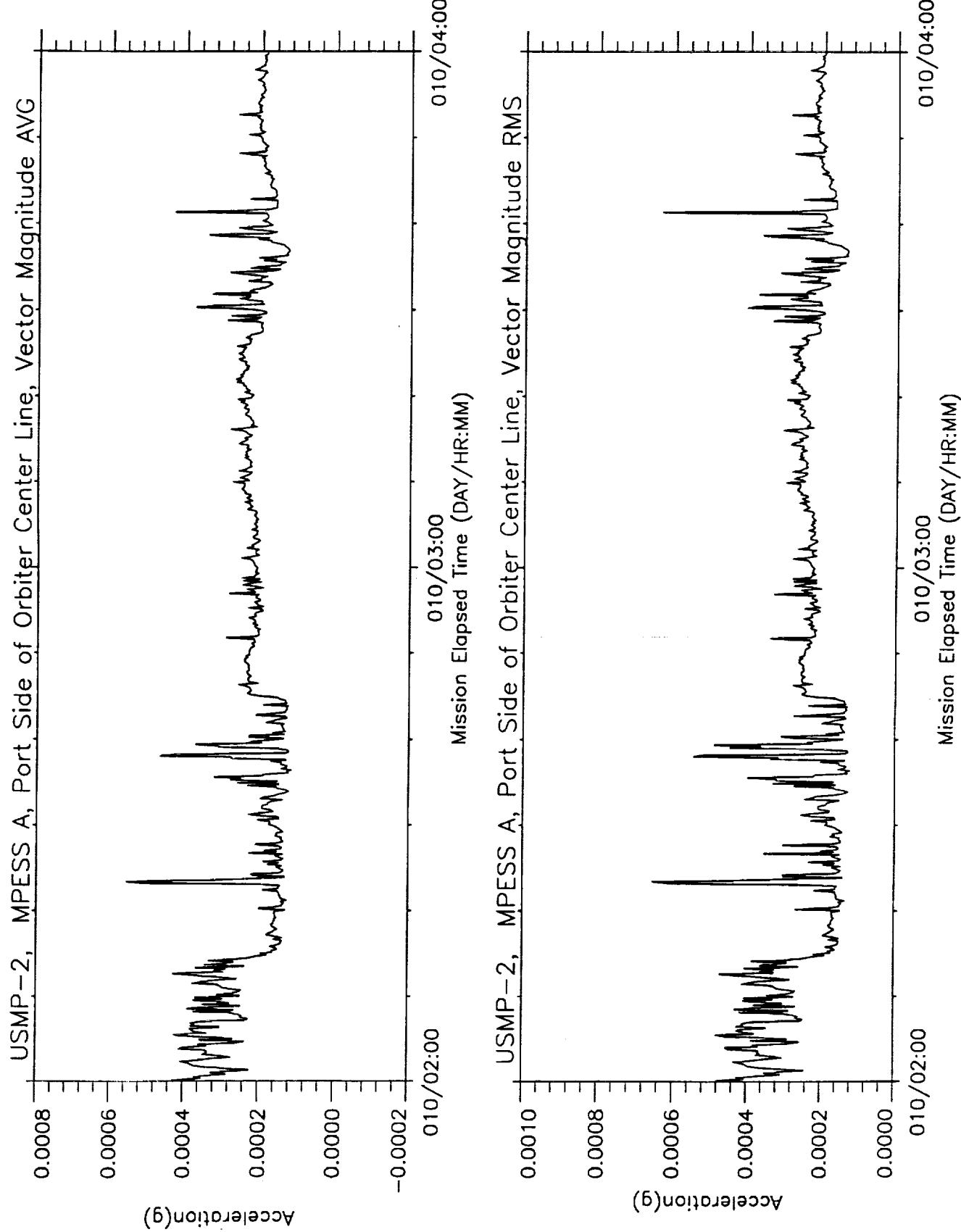
SUMMARY REPORT OF MISSION ACCELERATION MEASUREMENTS FOR STS-62



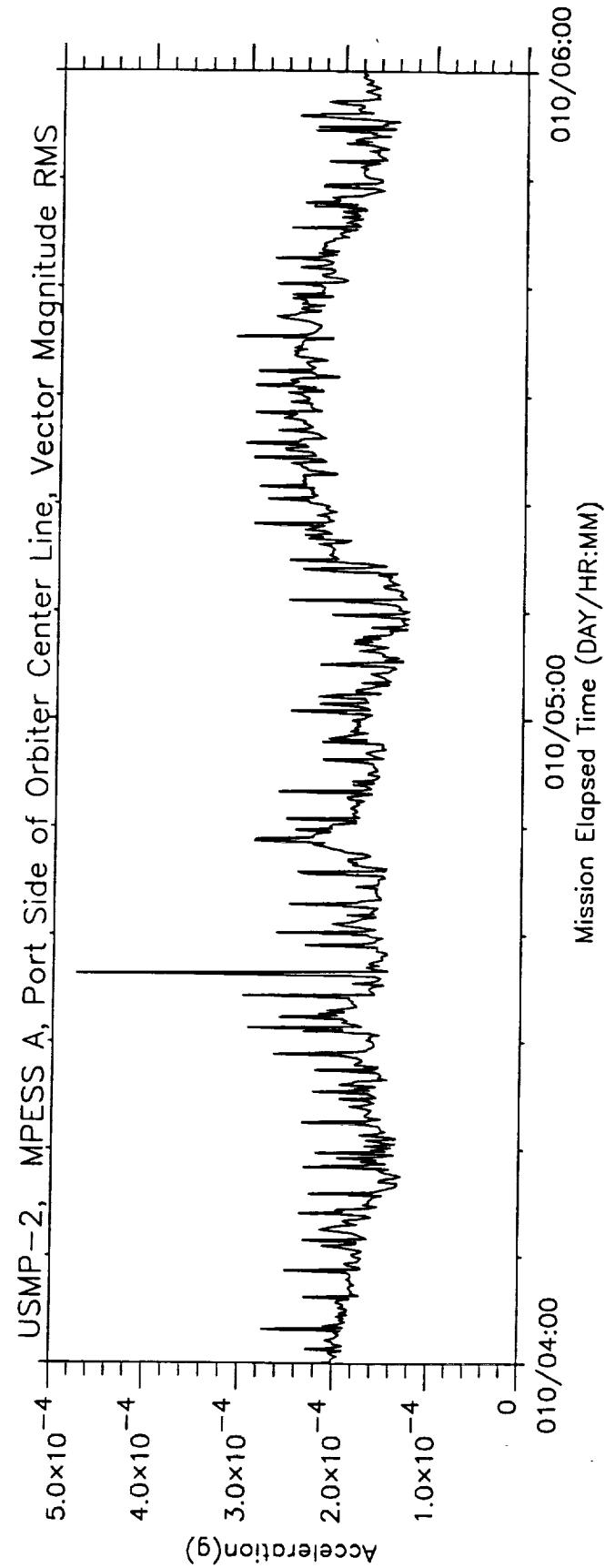
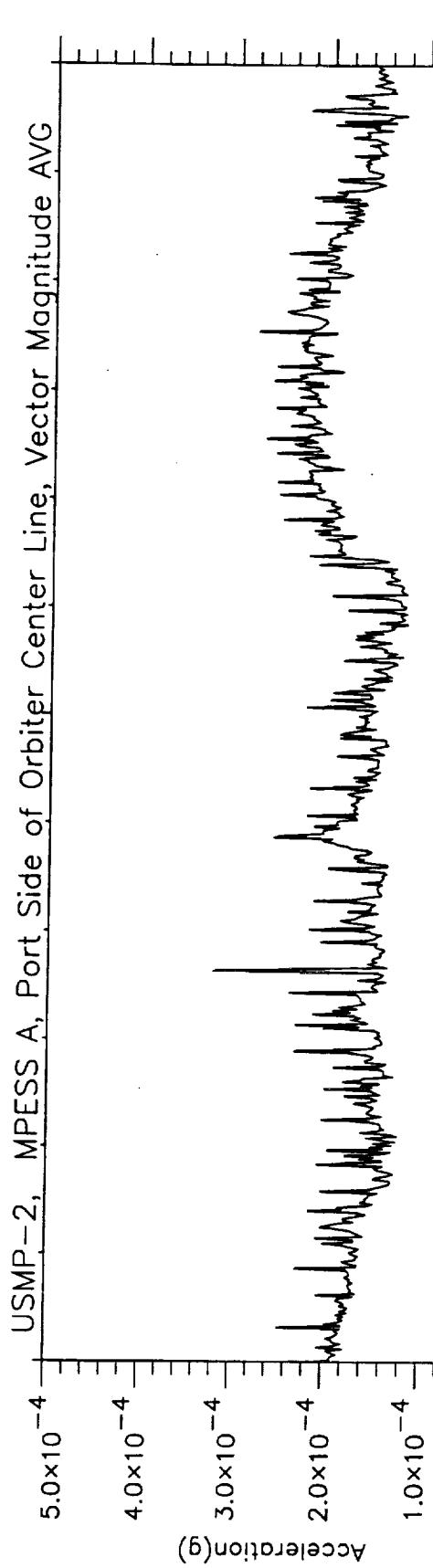
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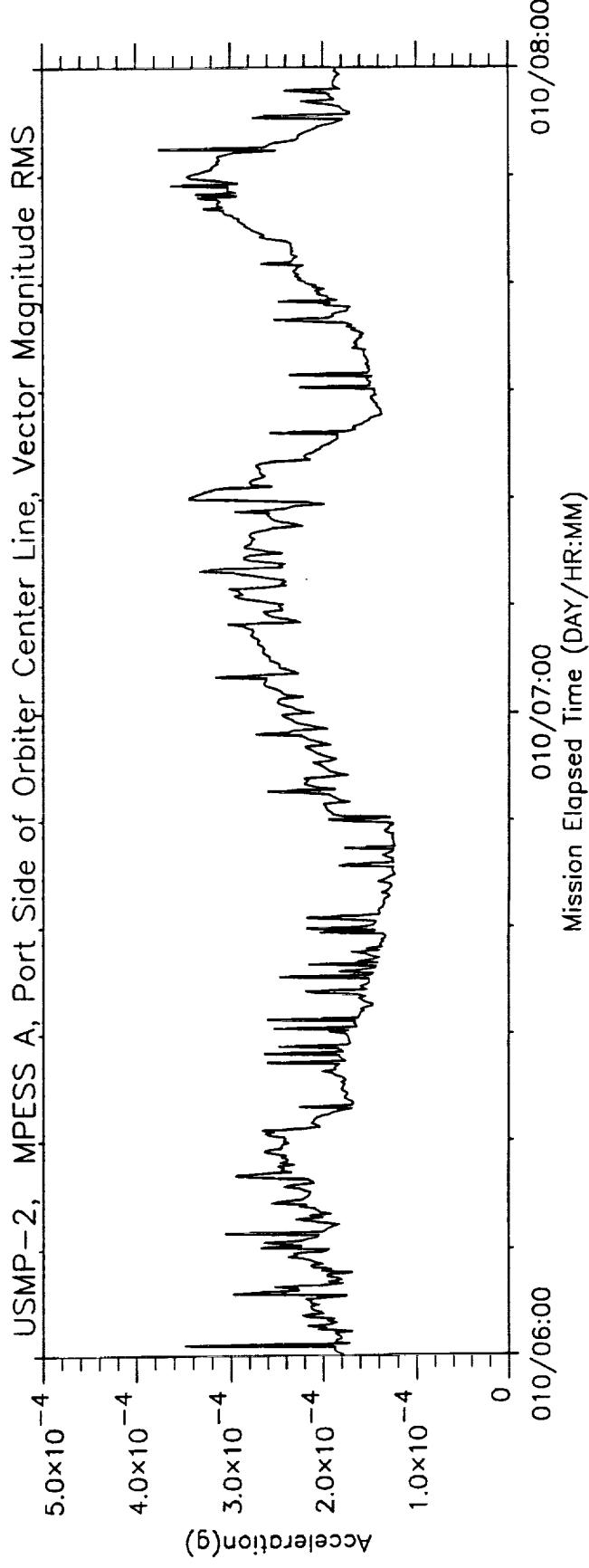
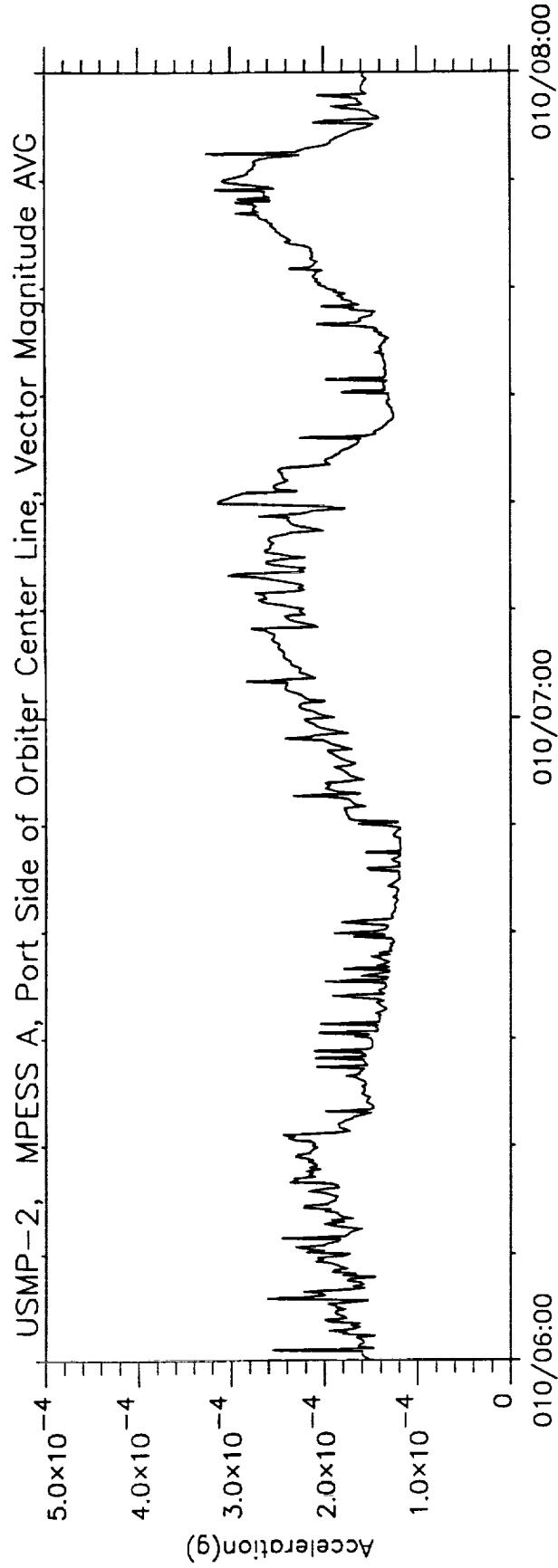
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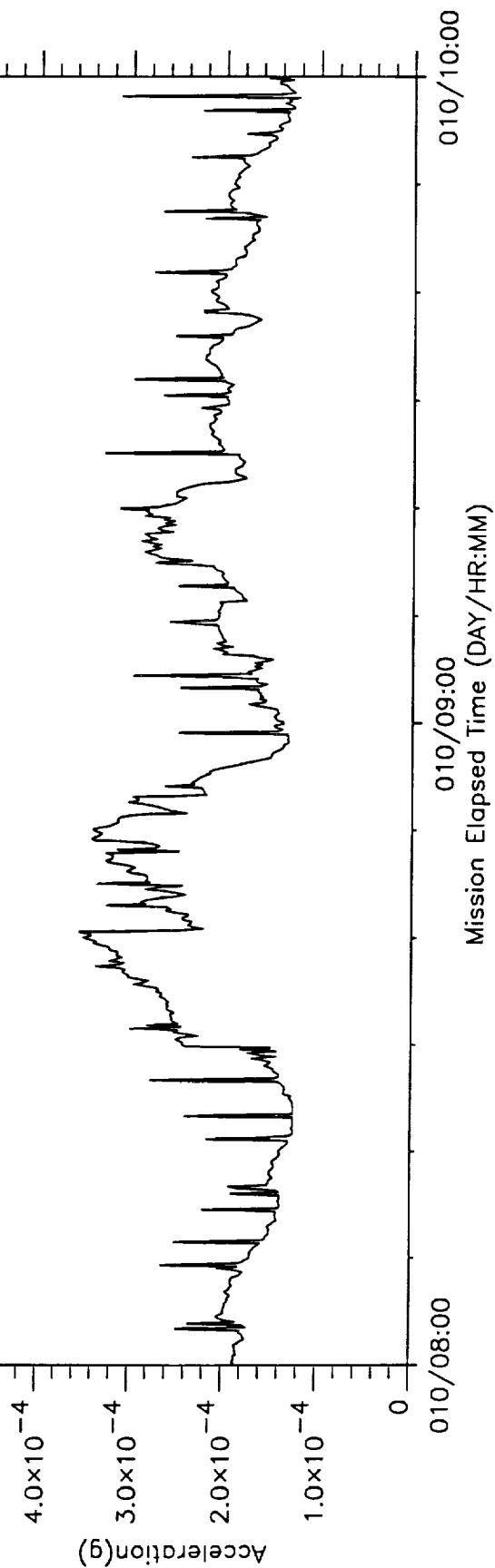
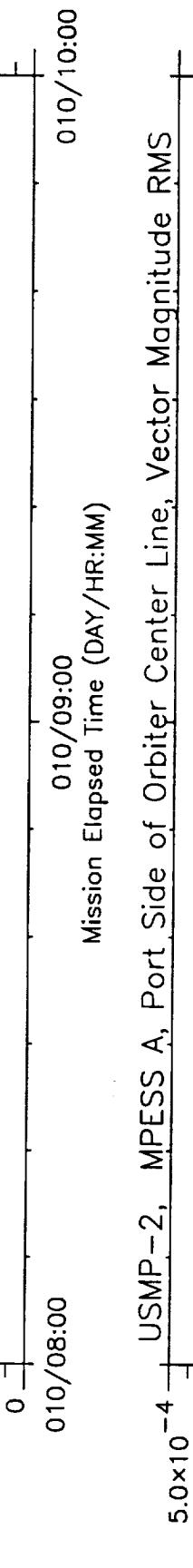
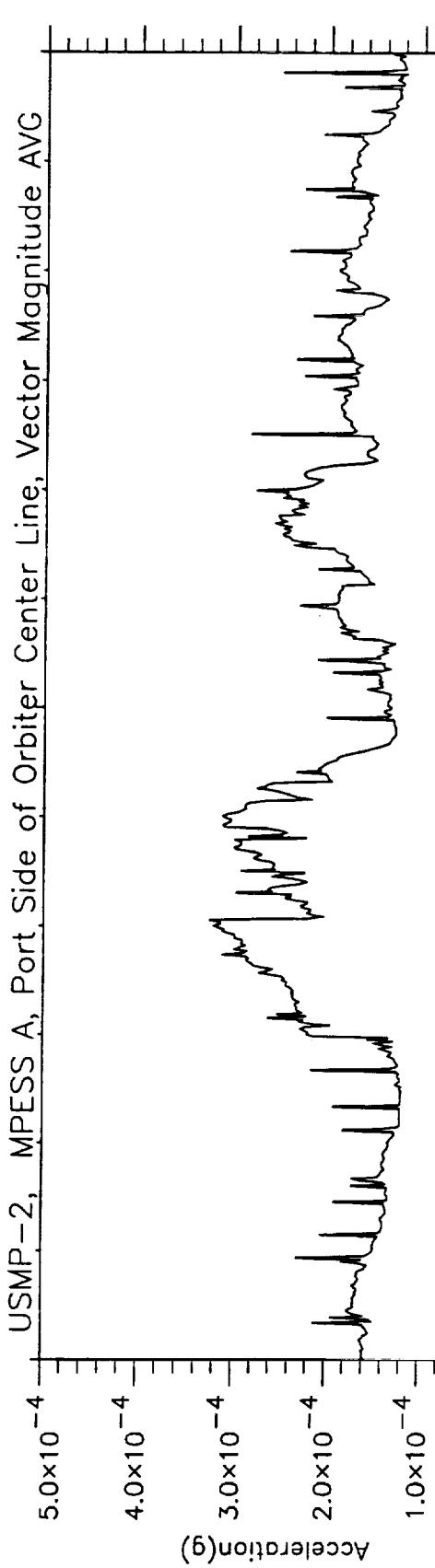
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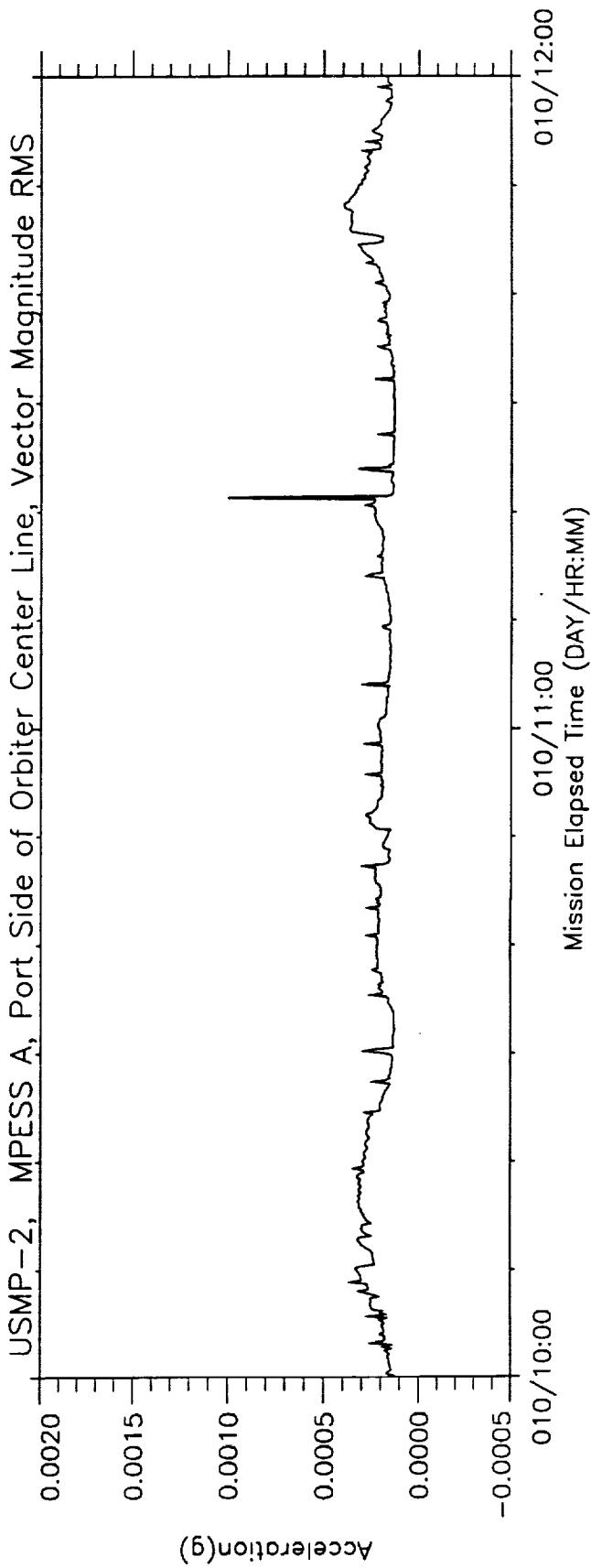
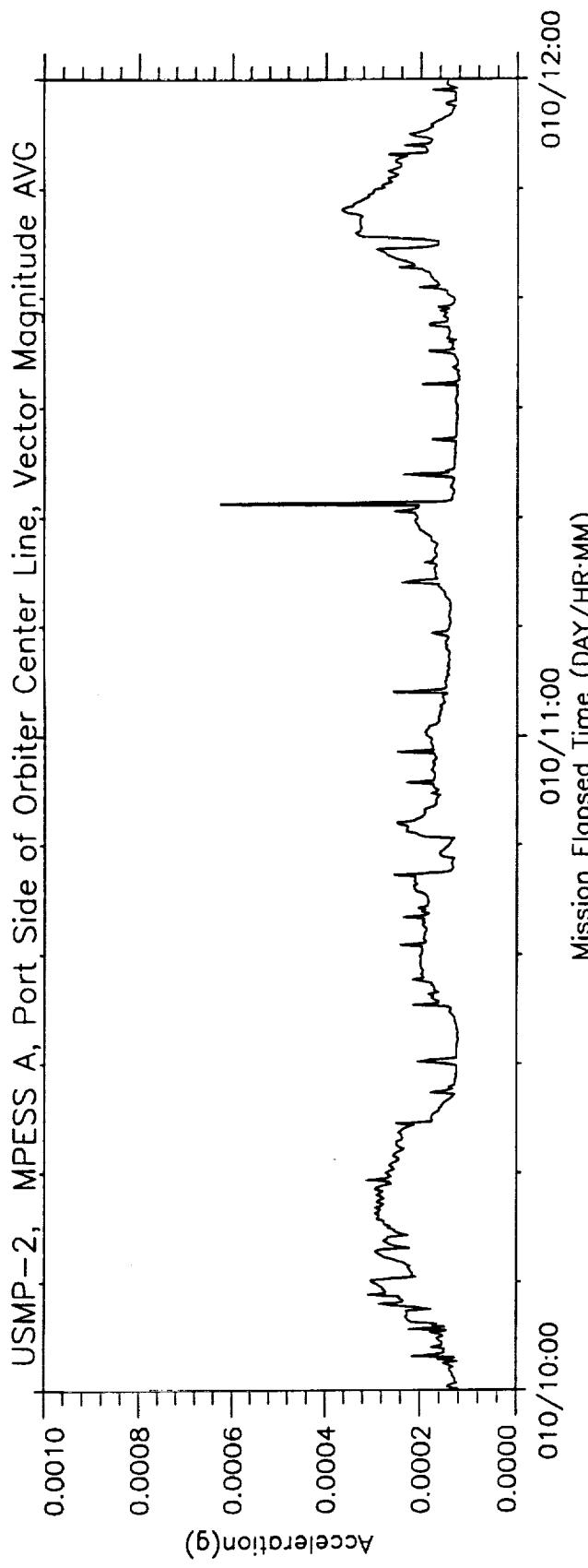
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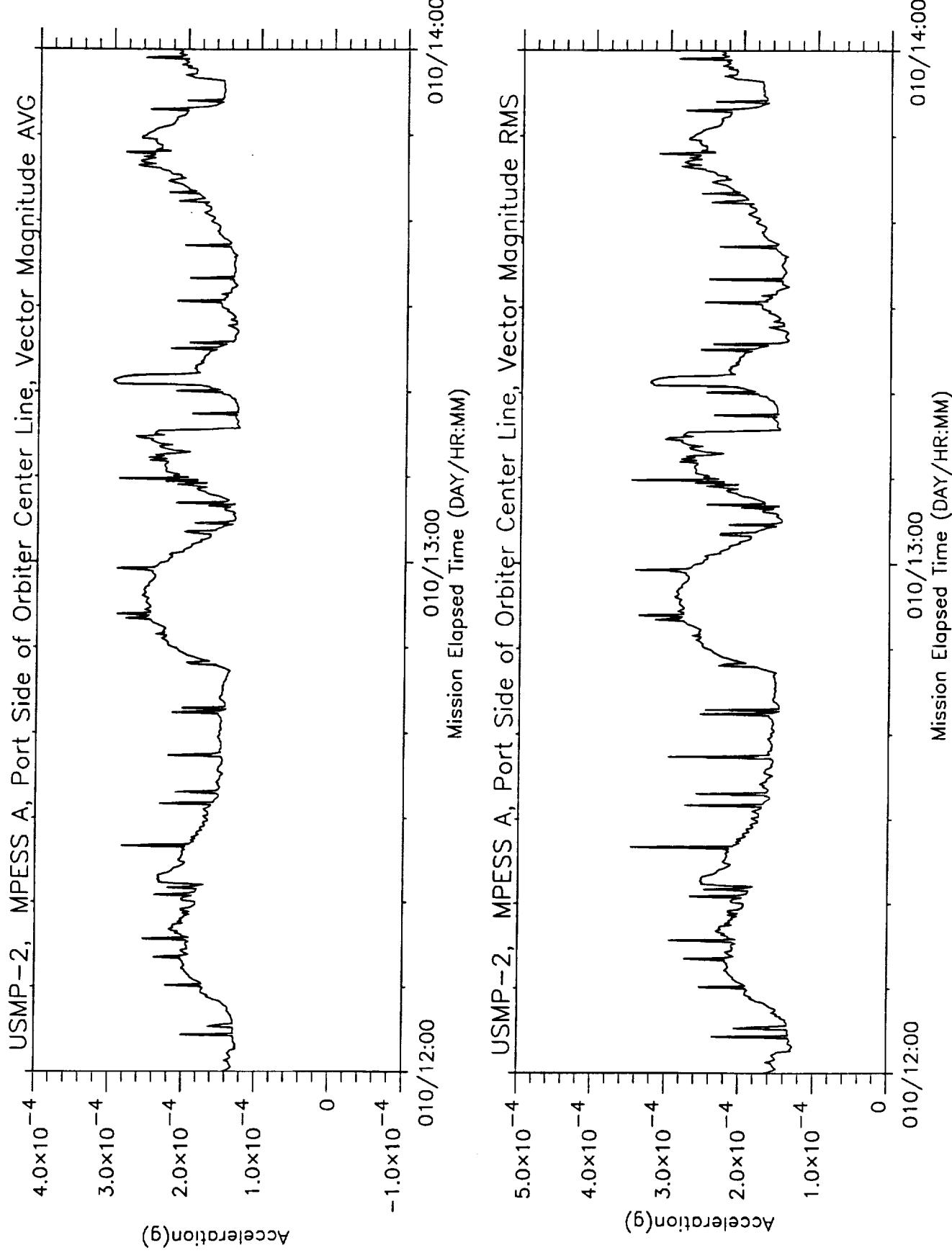
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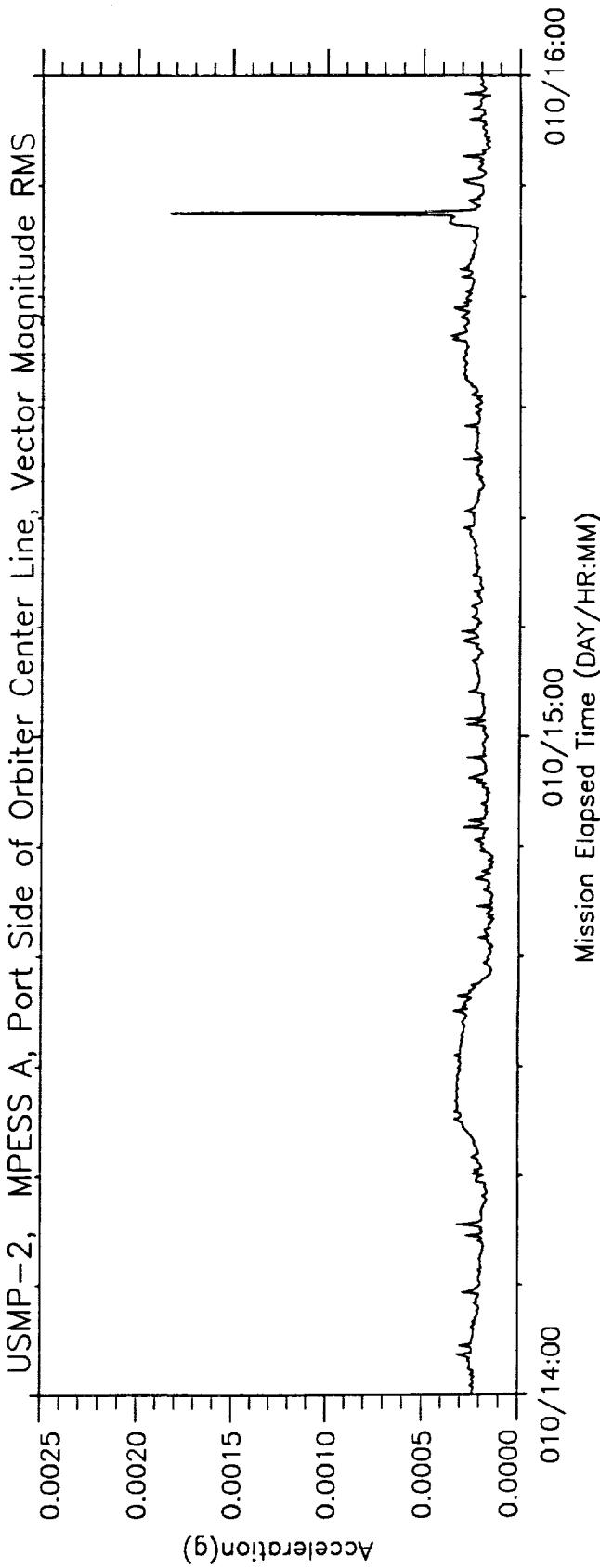
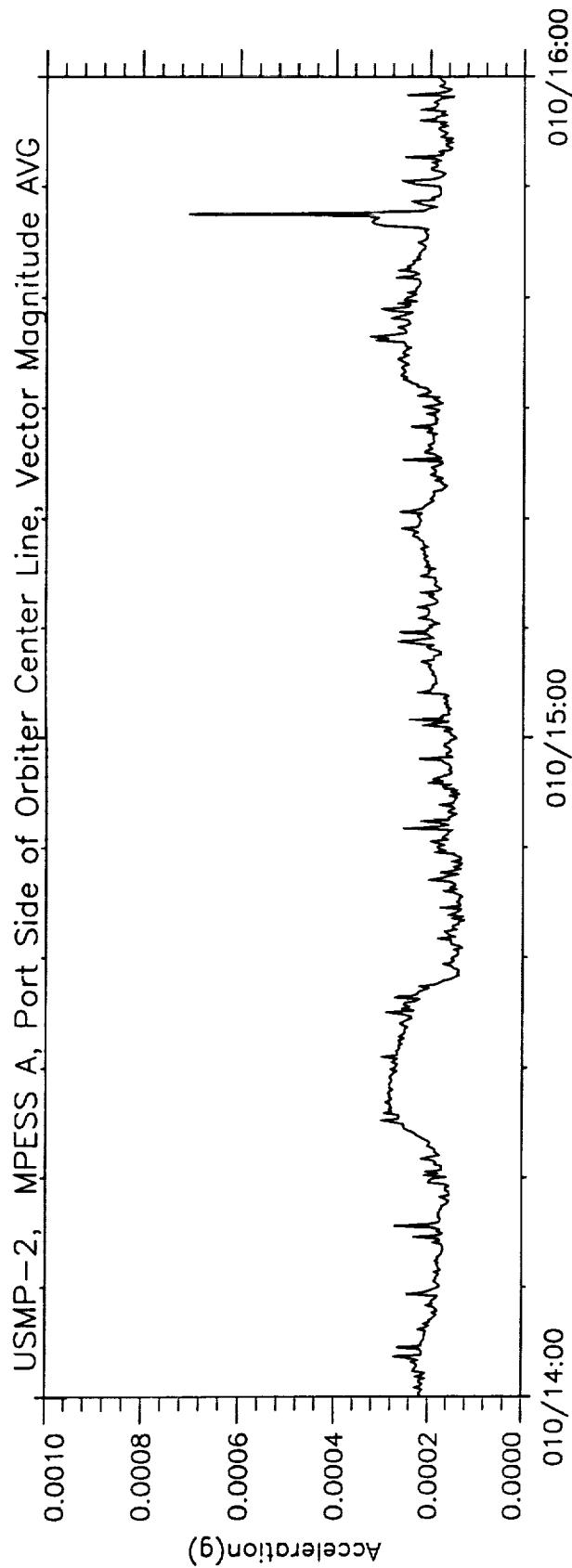
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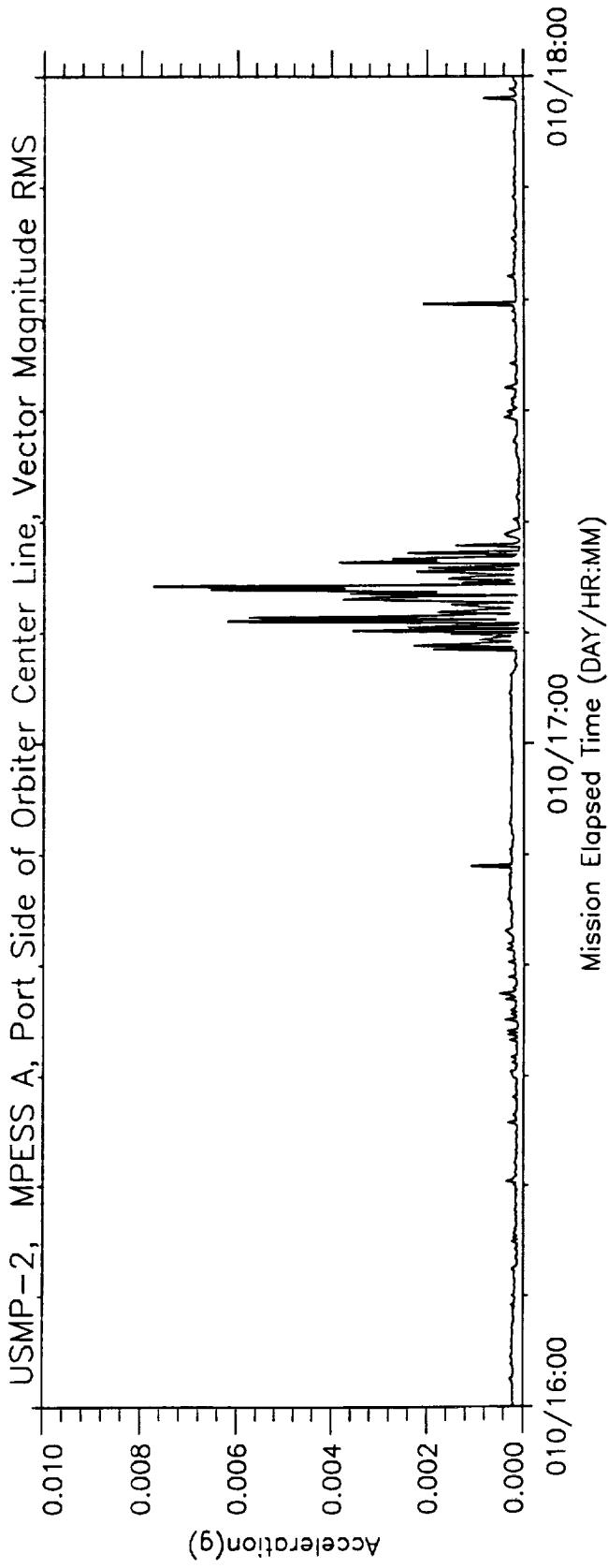
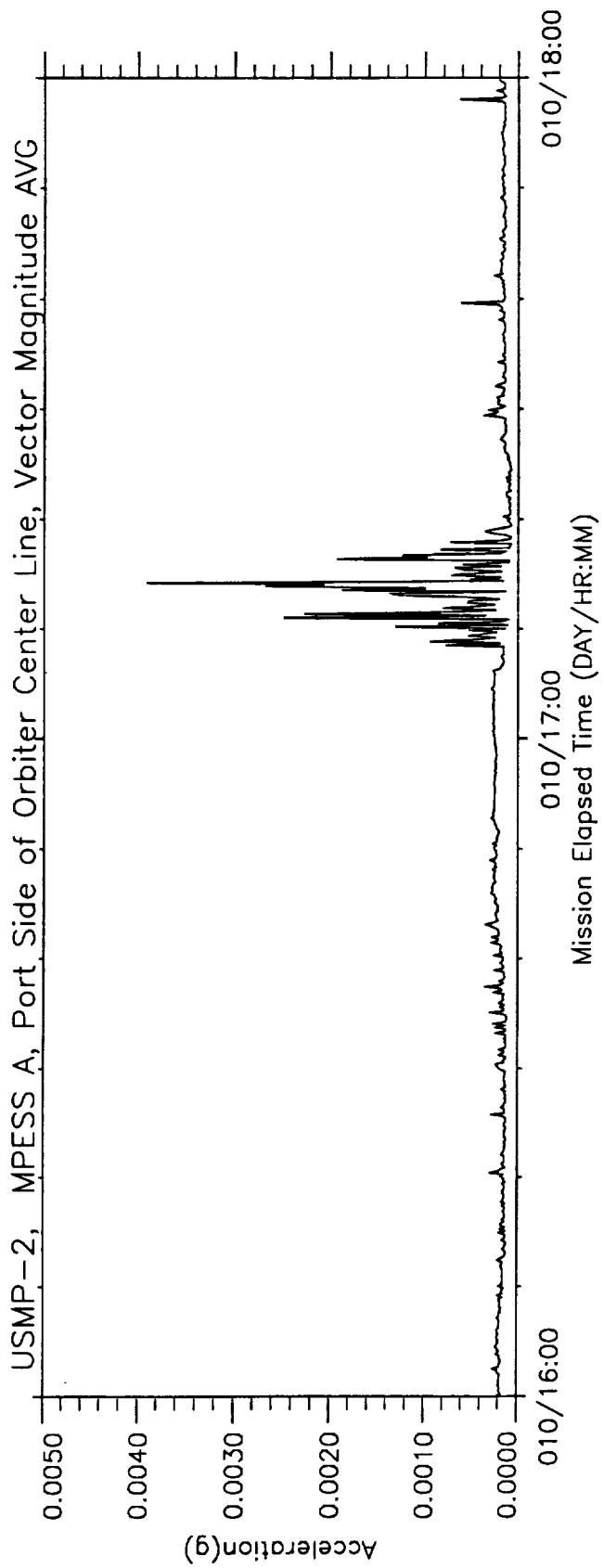
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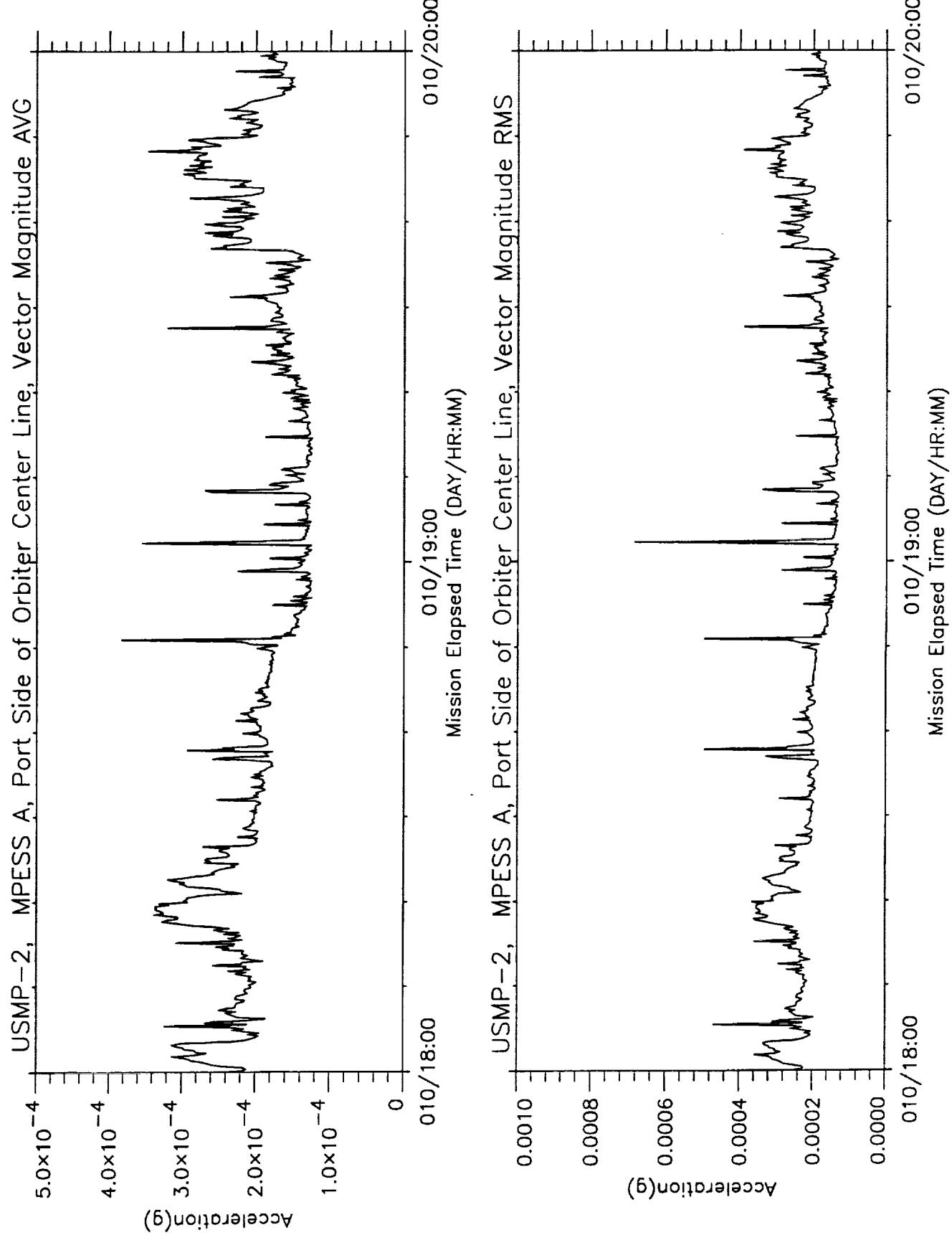
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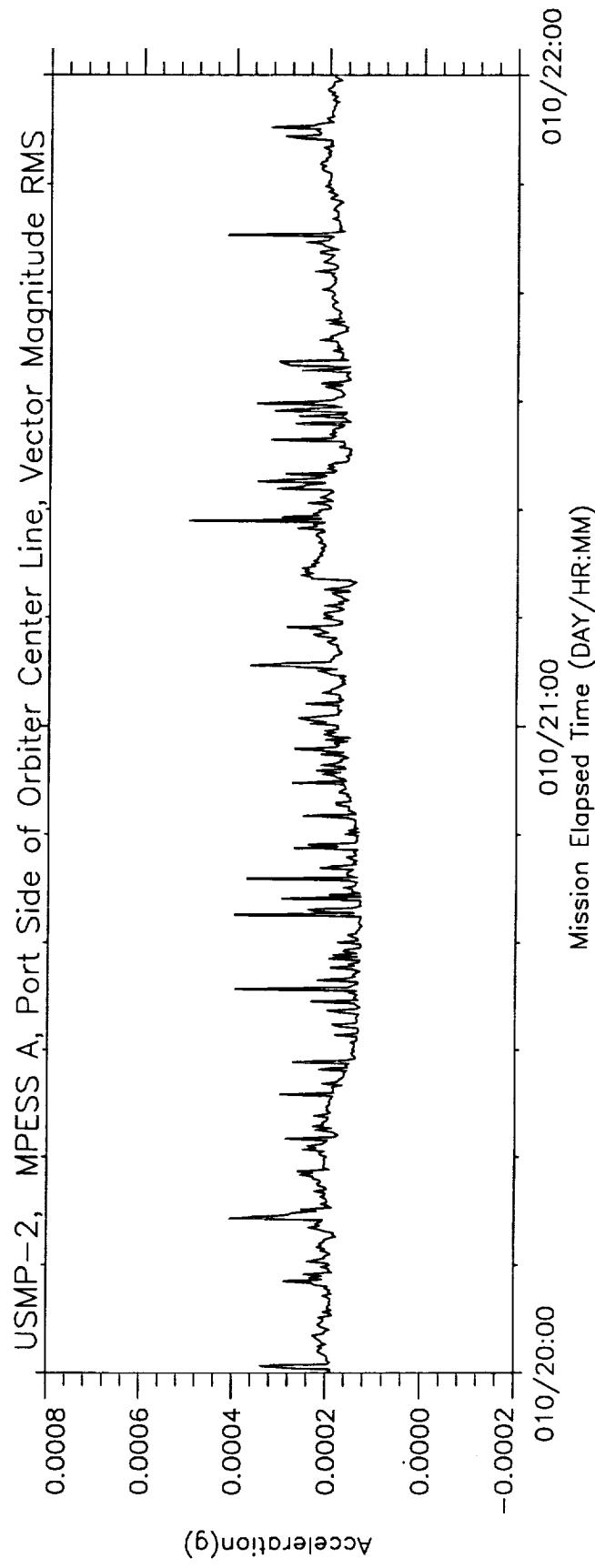
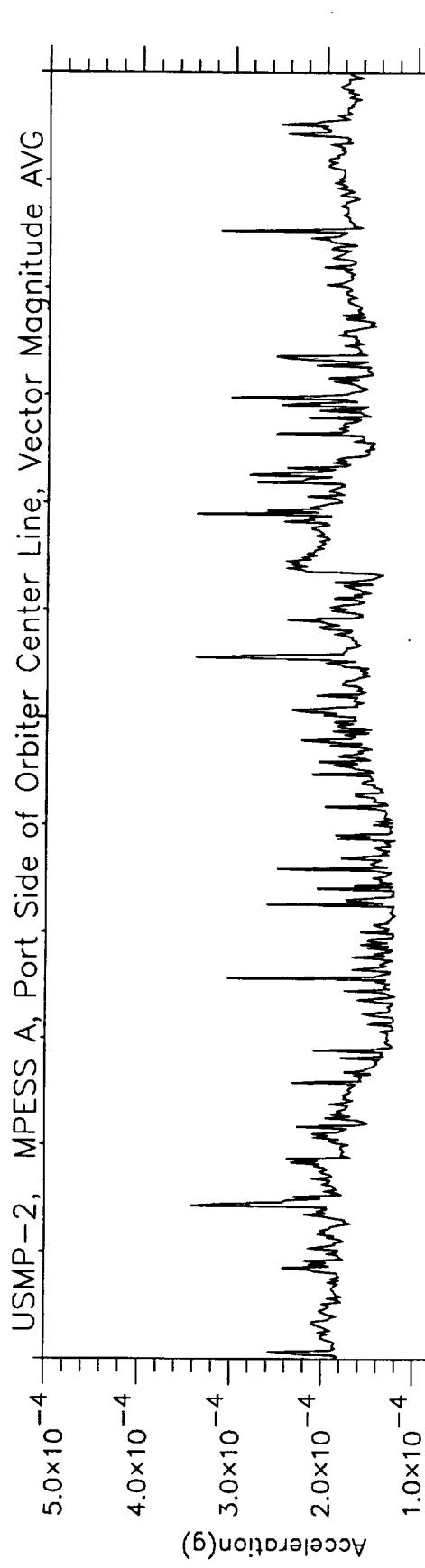
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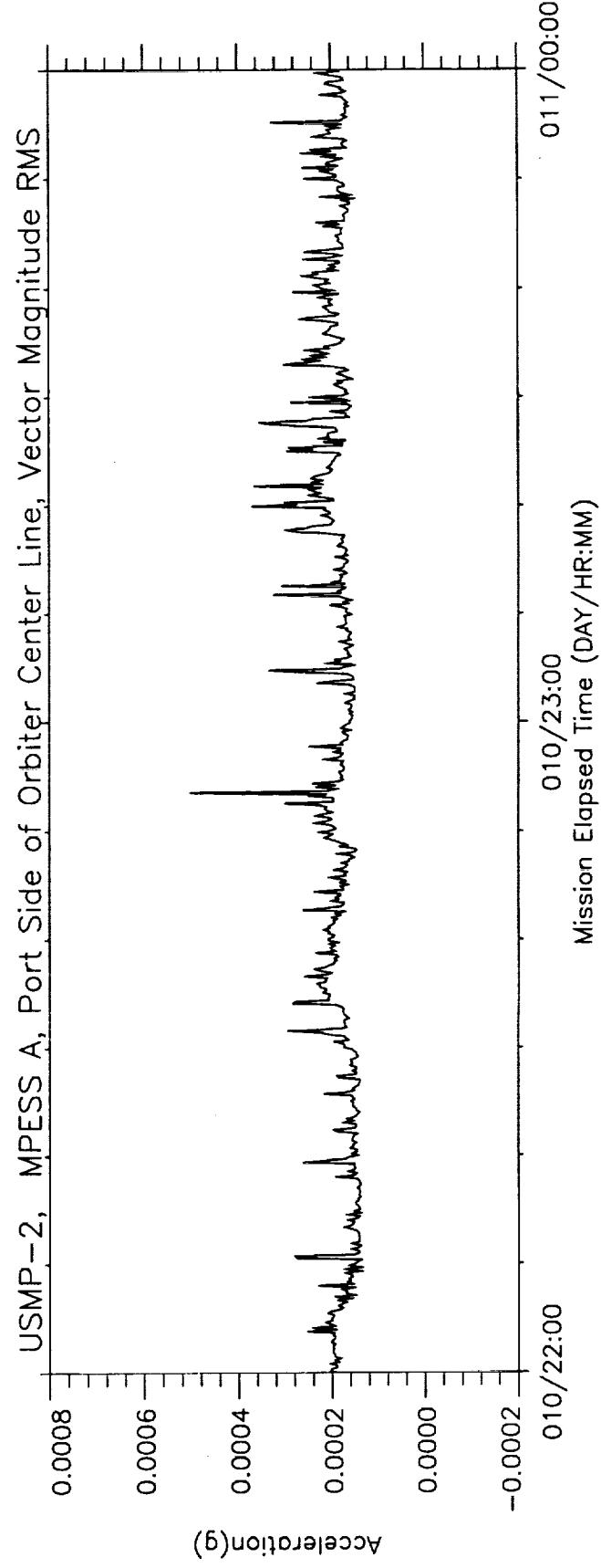
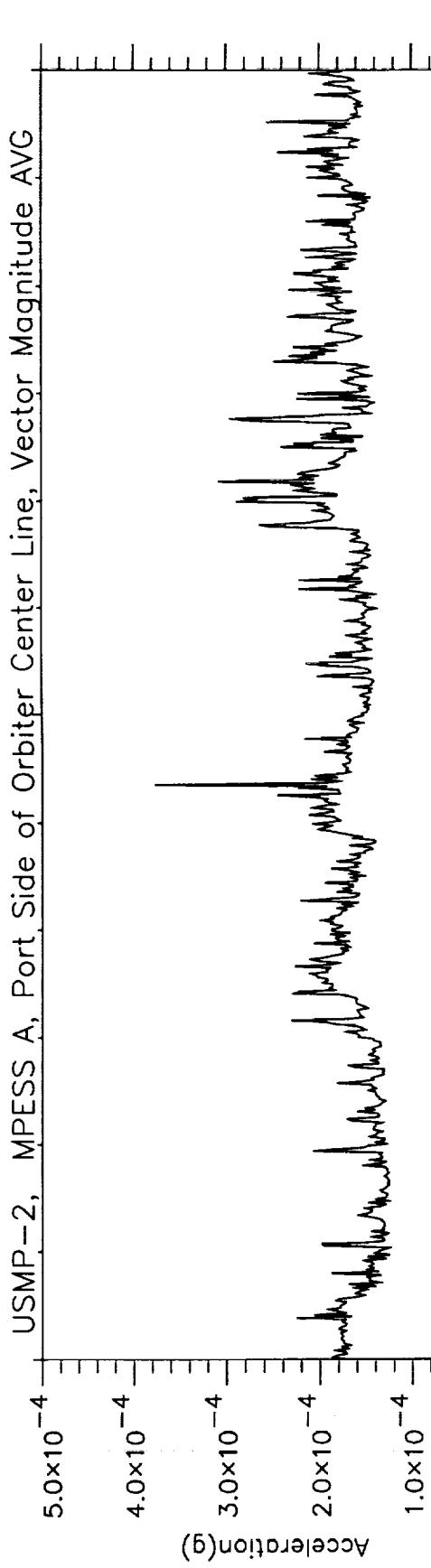
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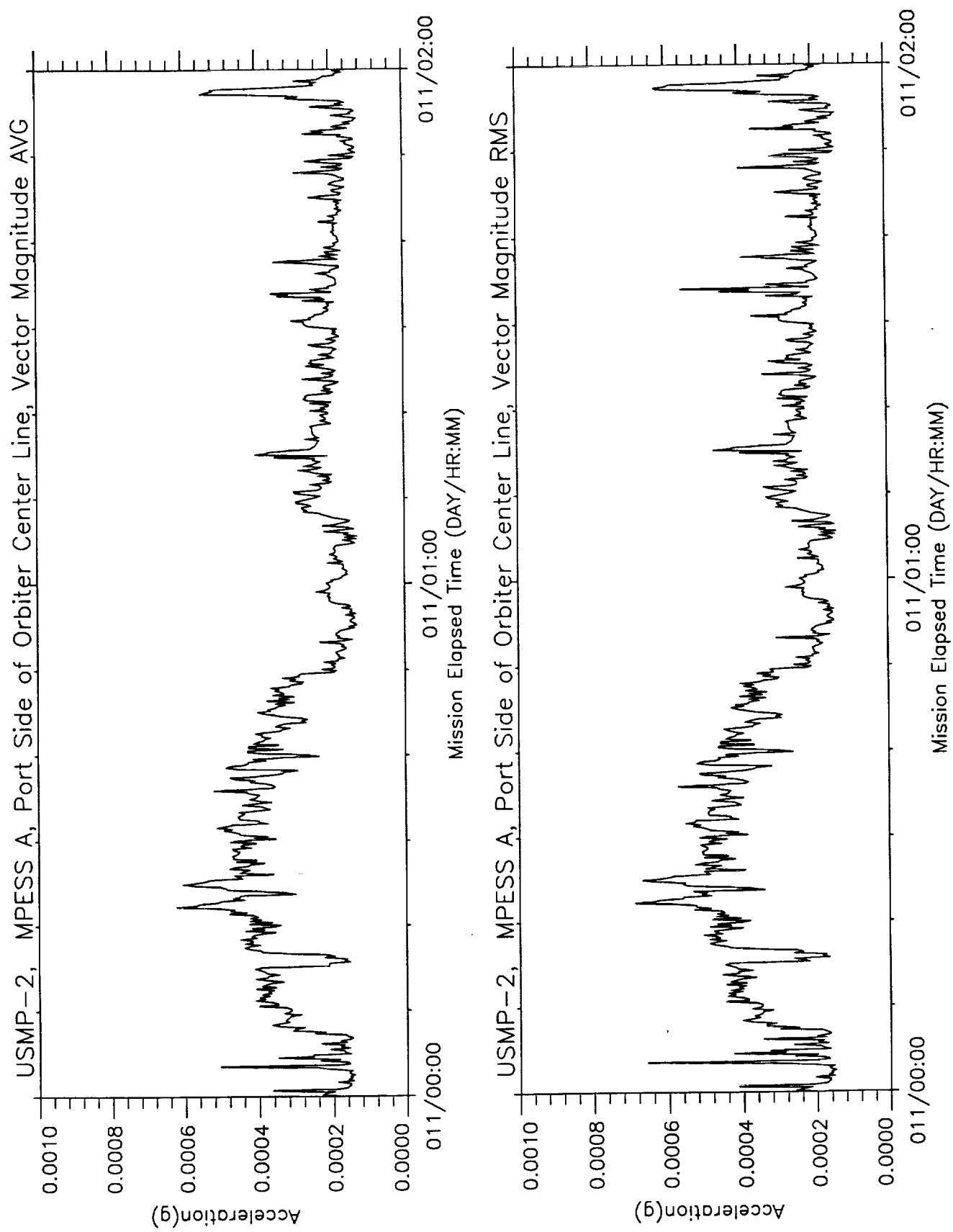
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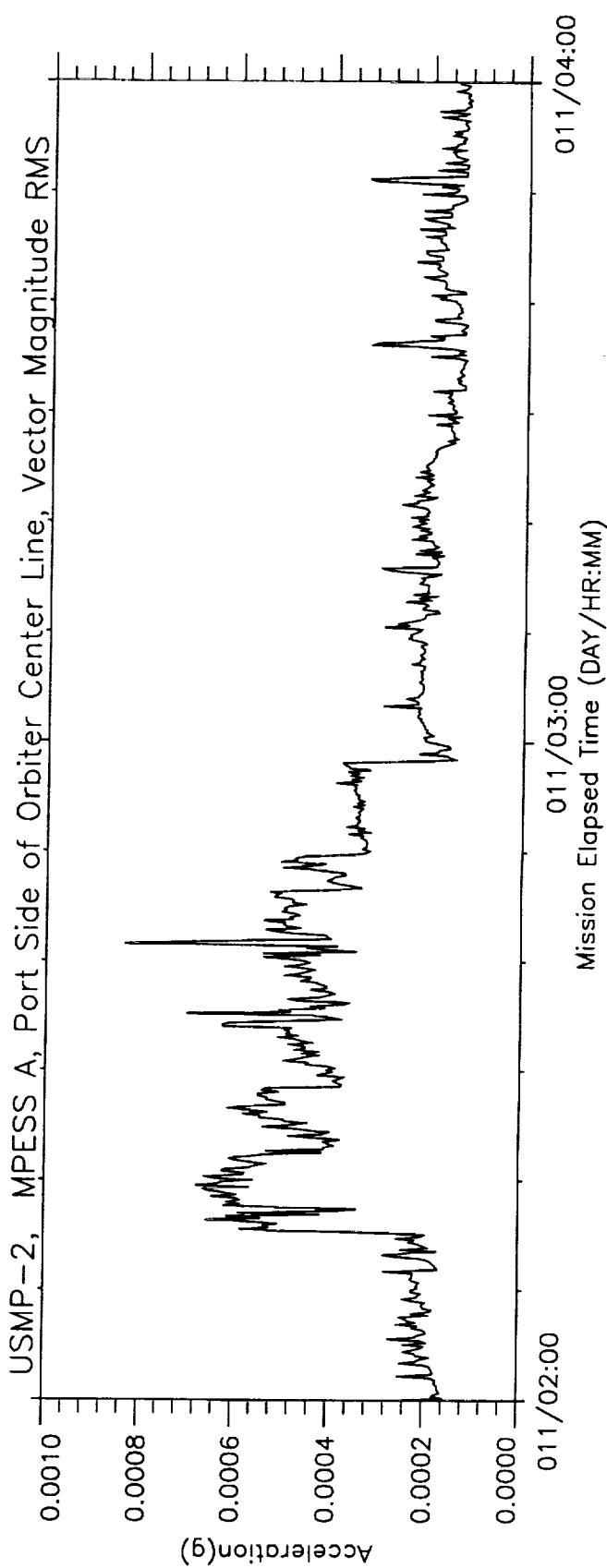
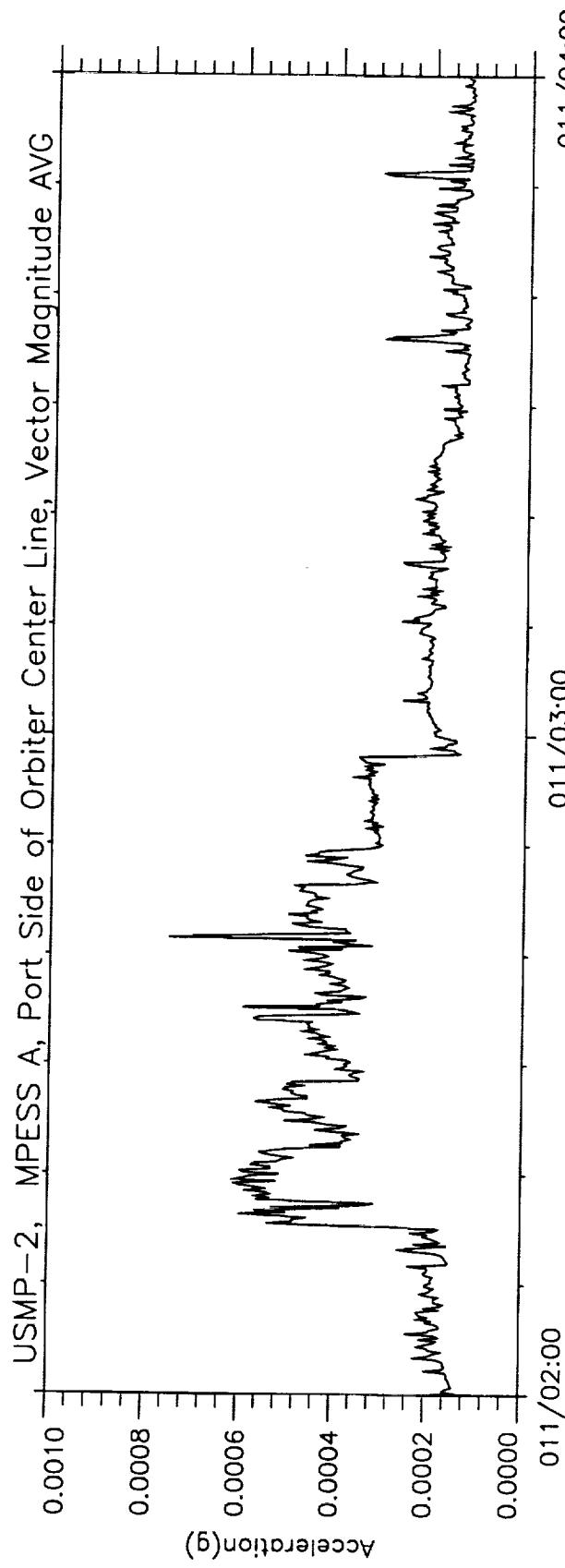
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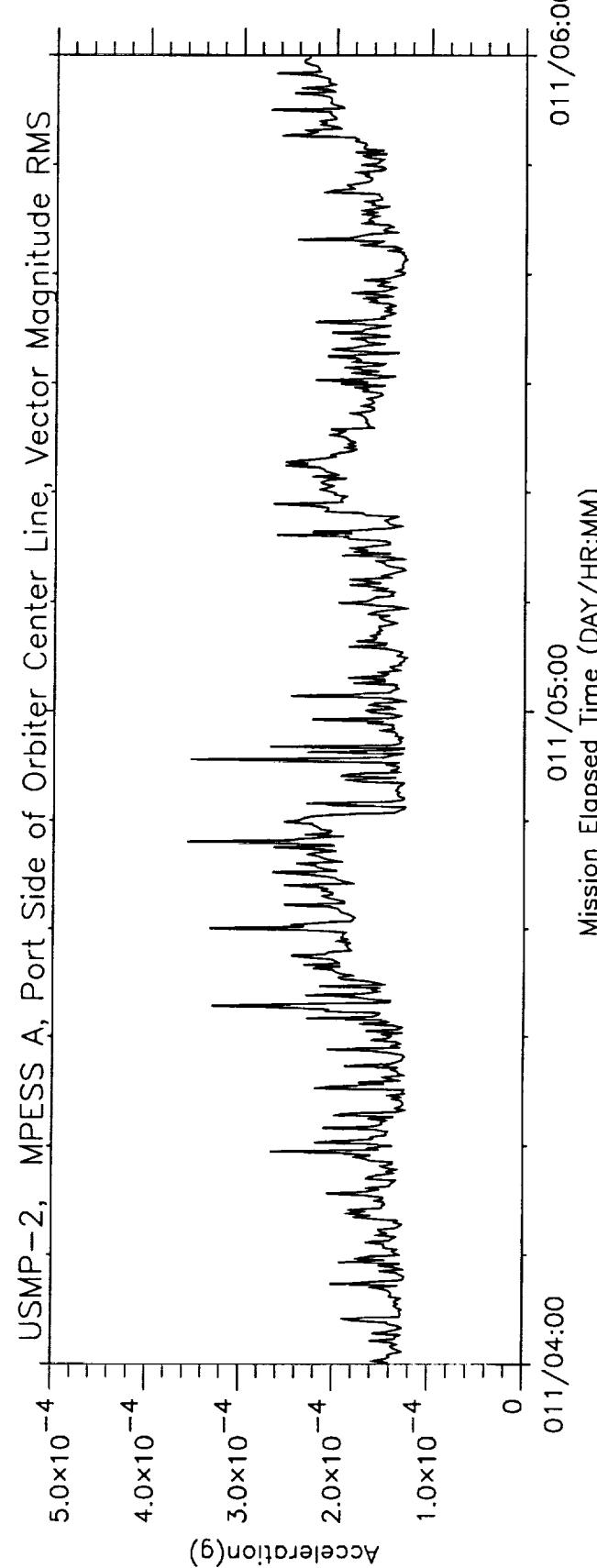
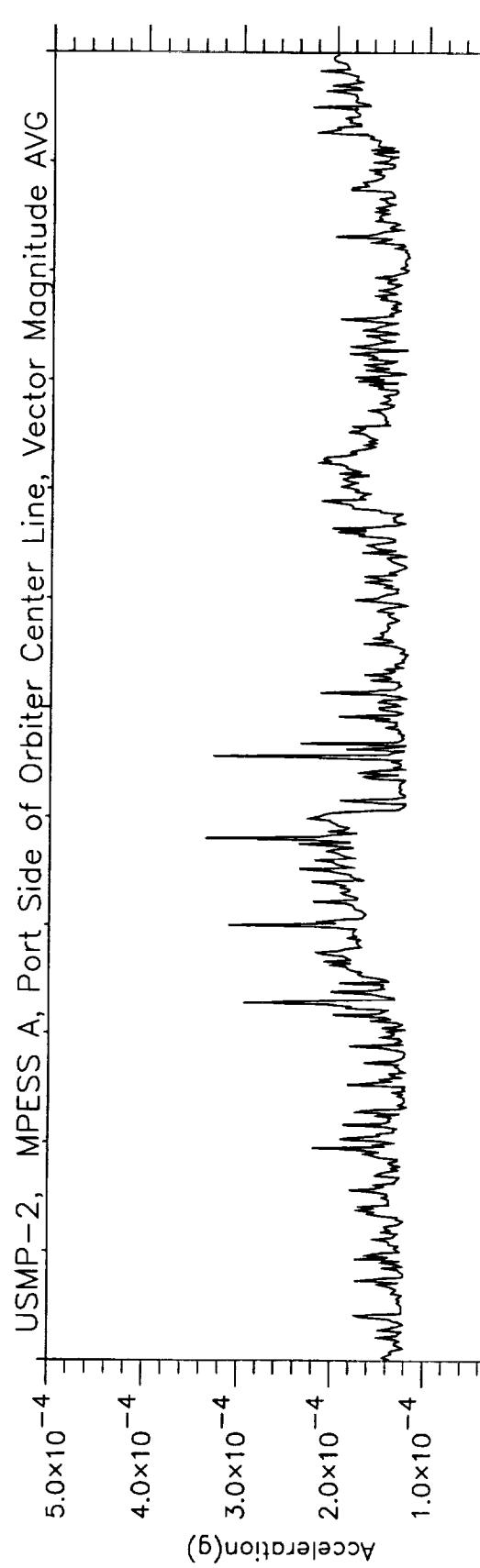
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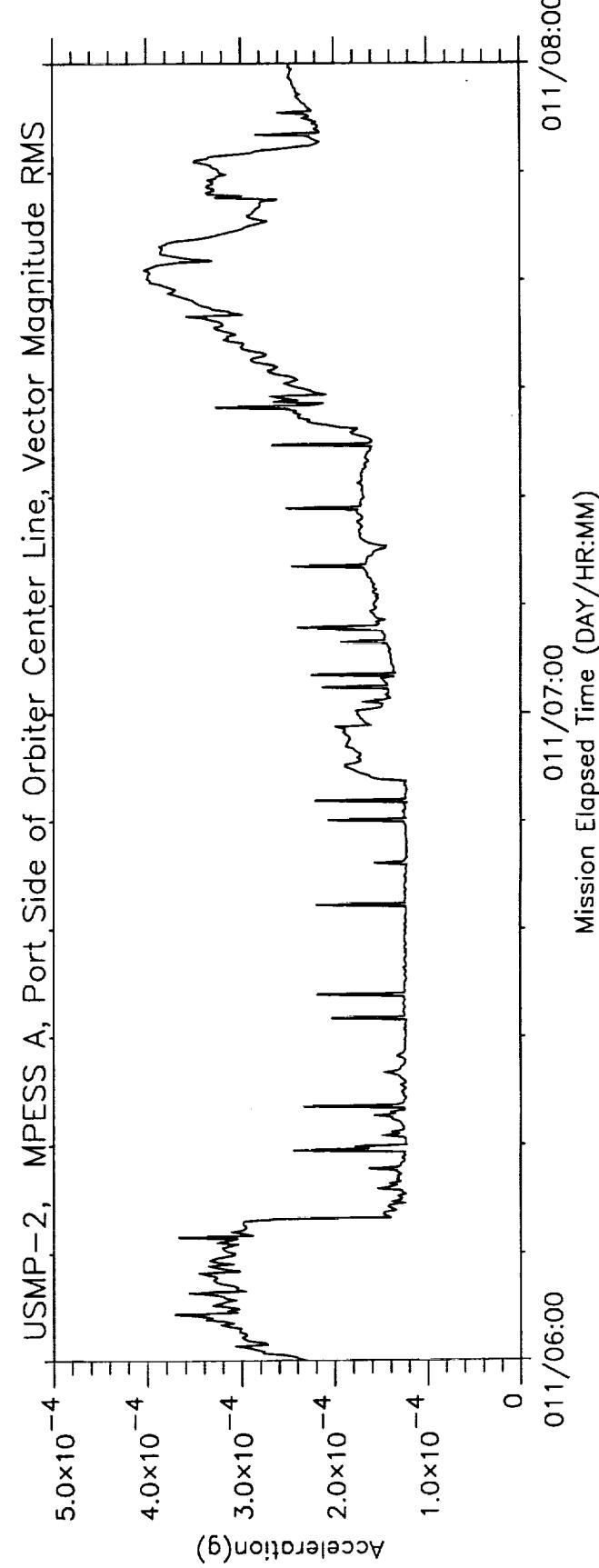
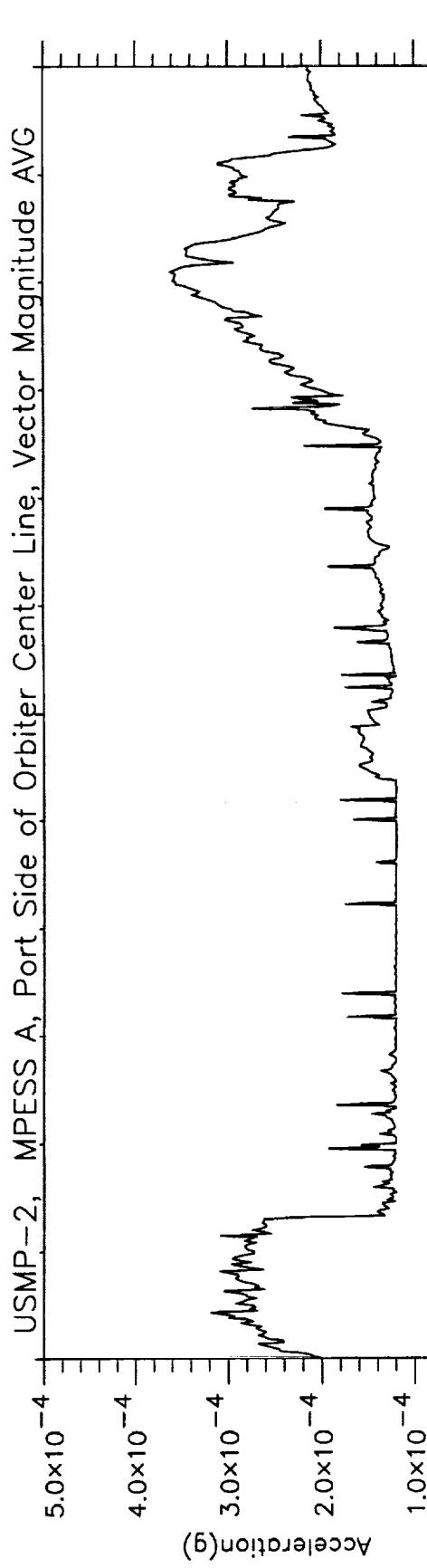
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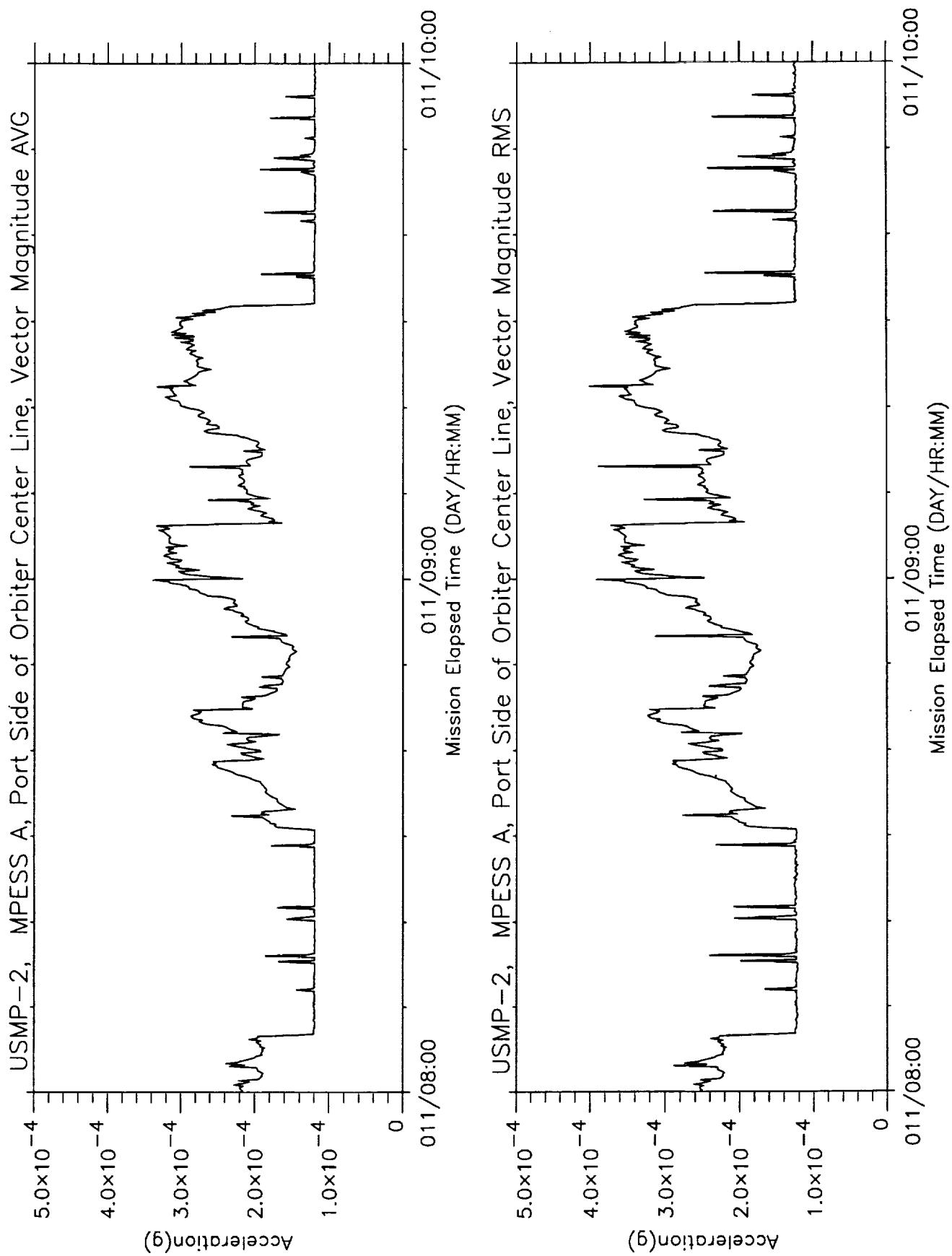
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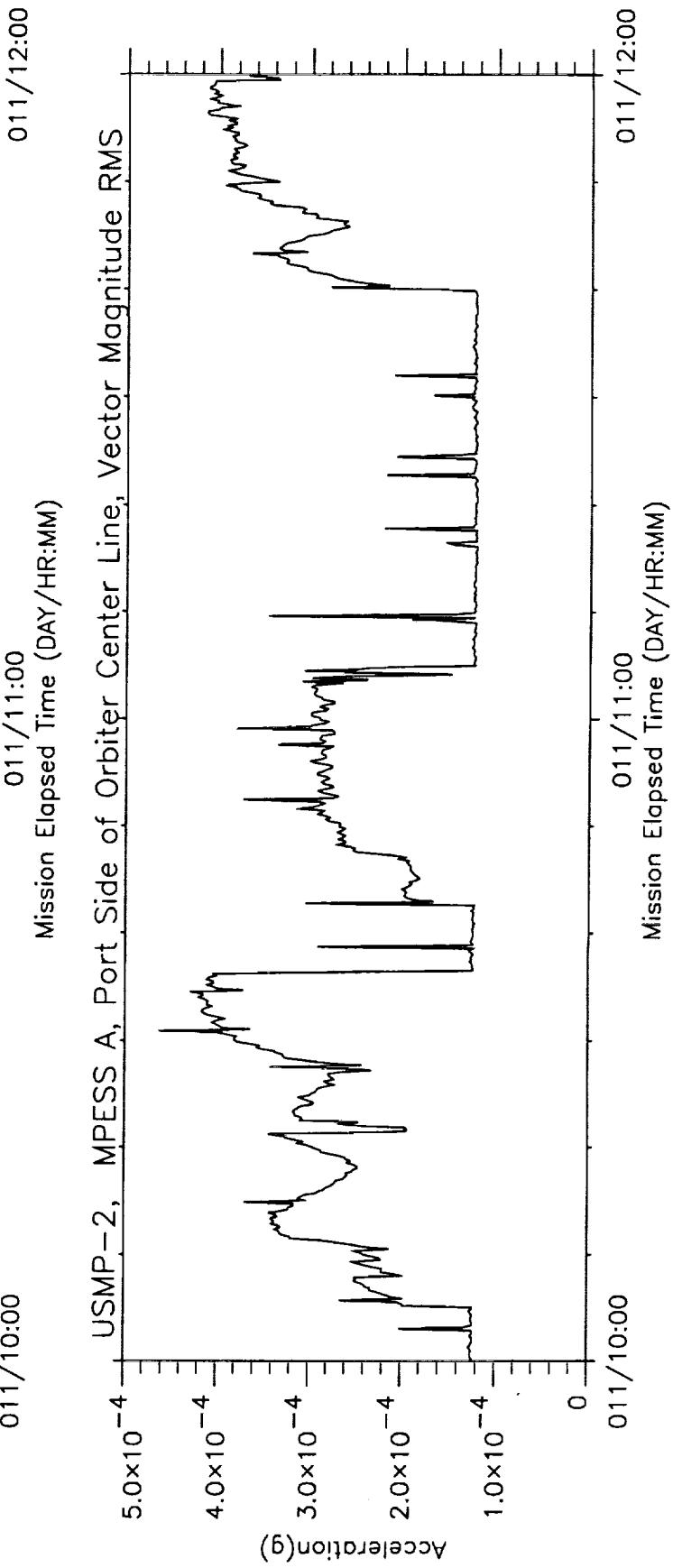
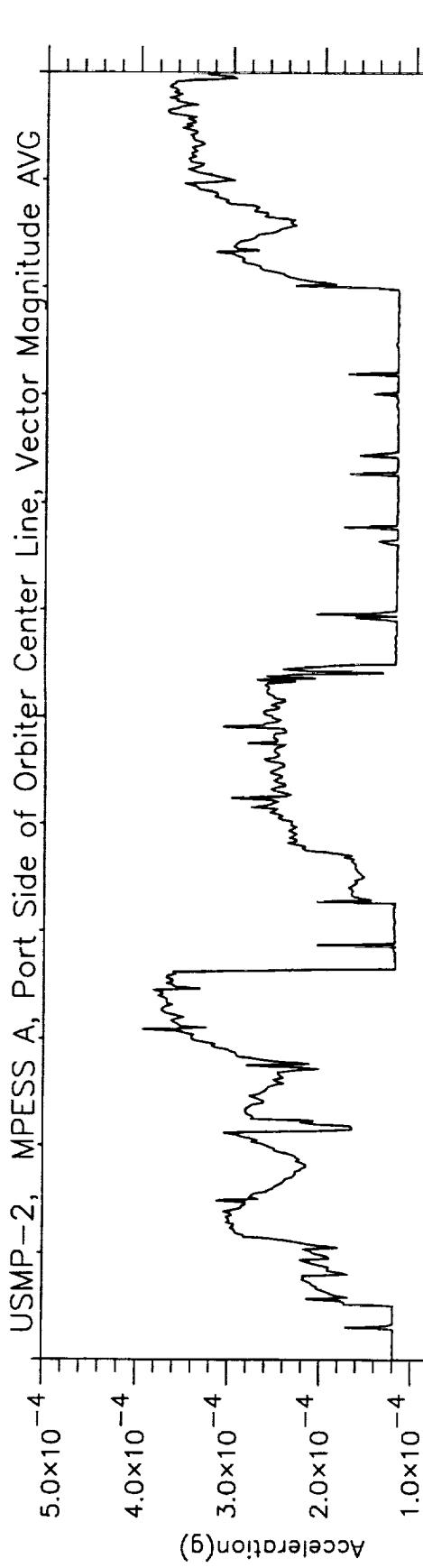
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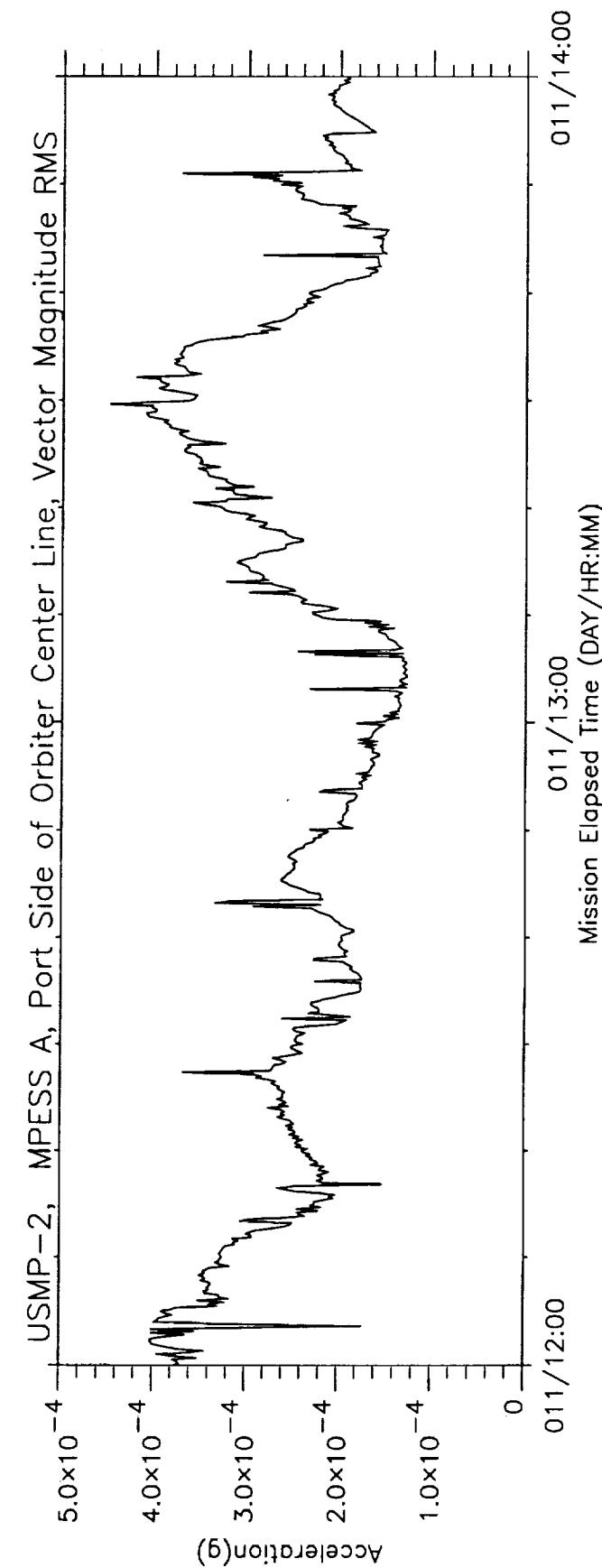
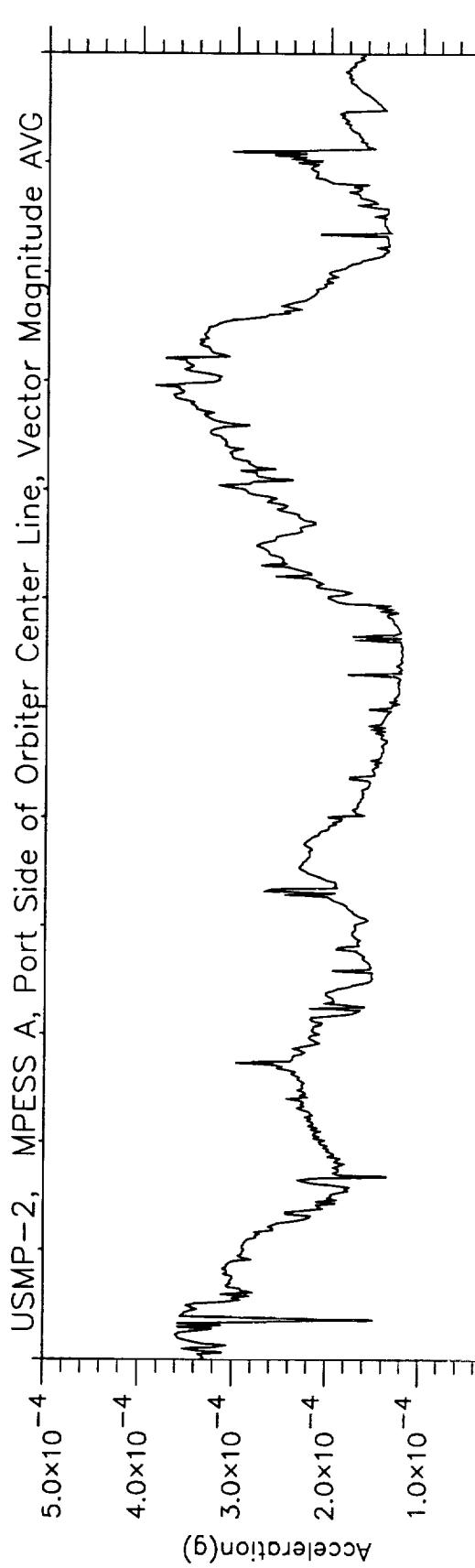
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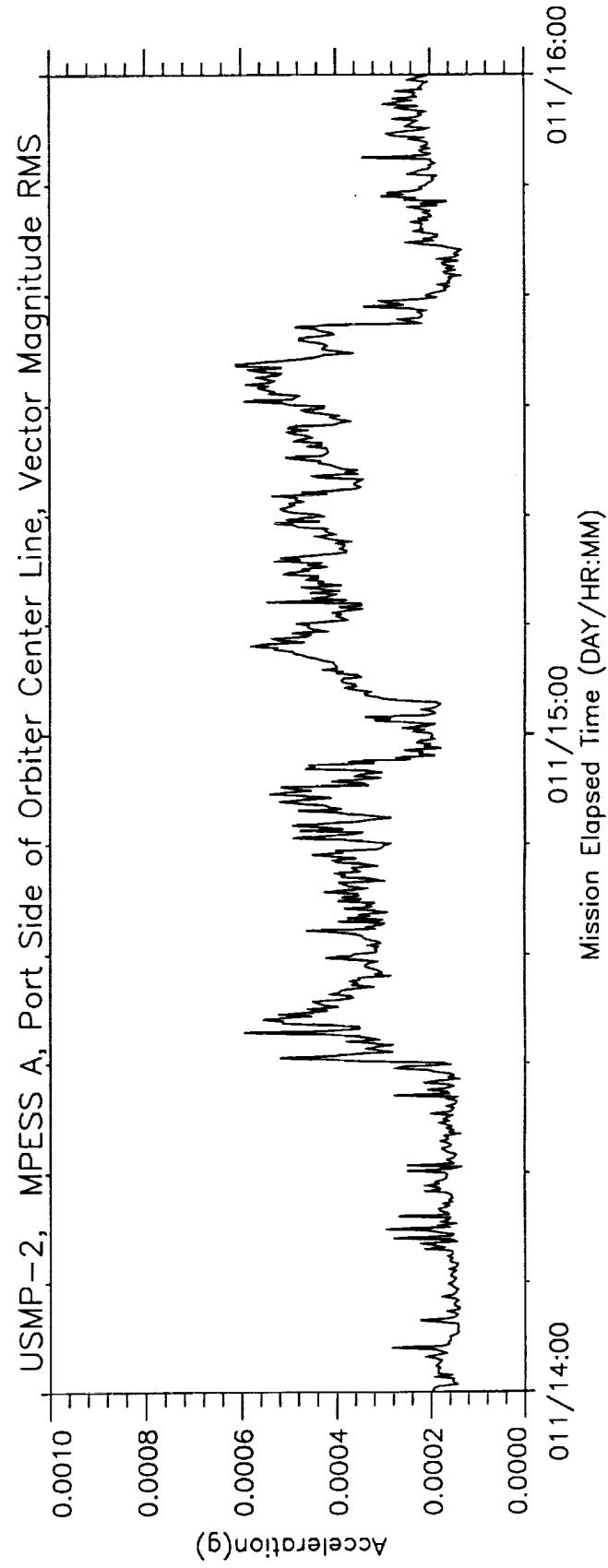
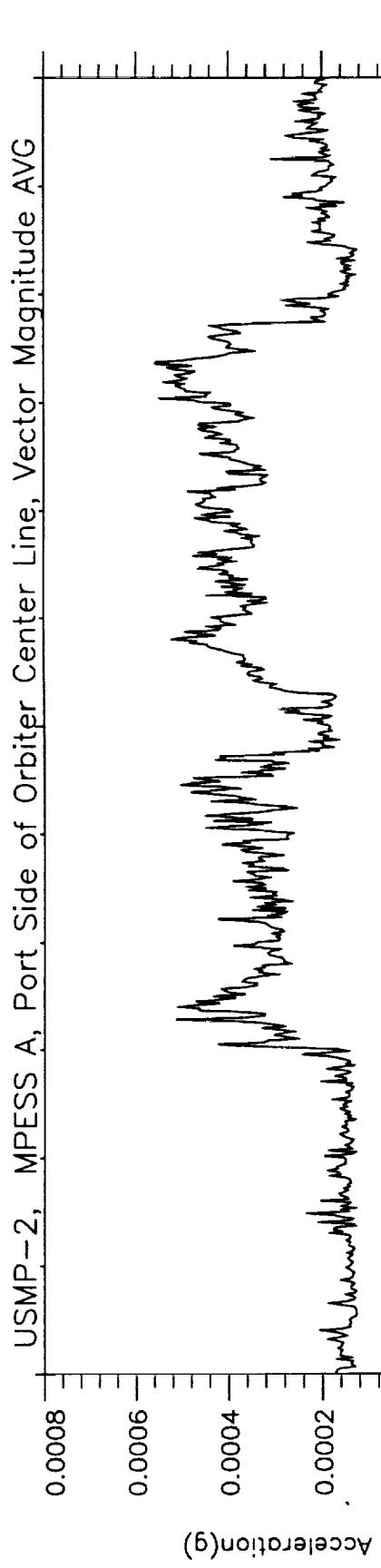
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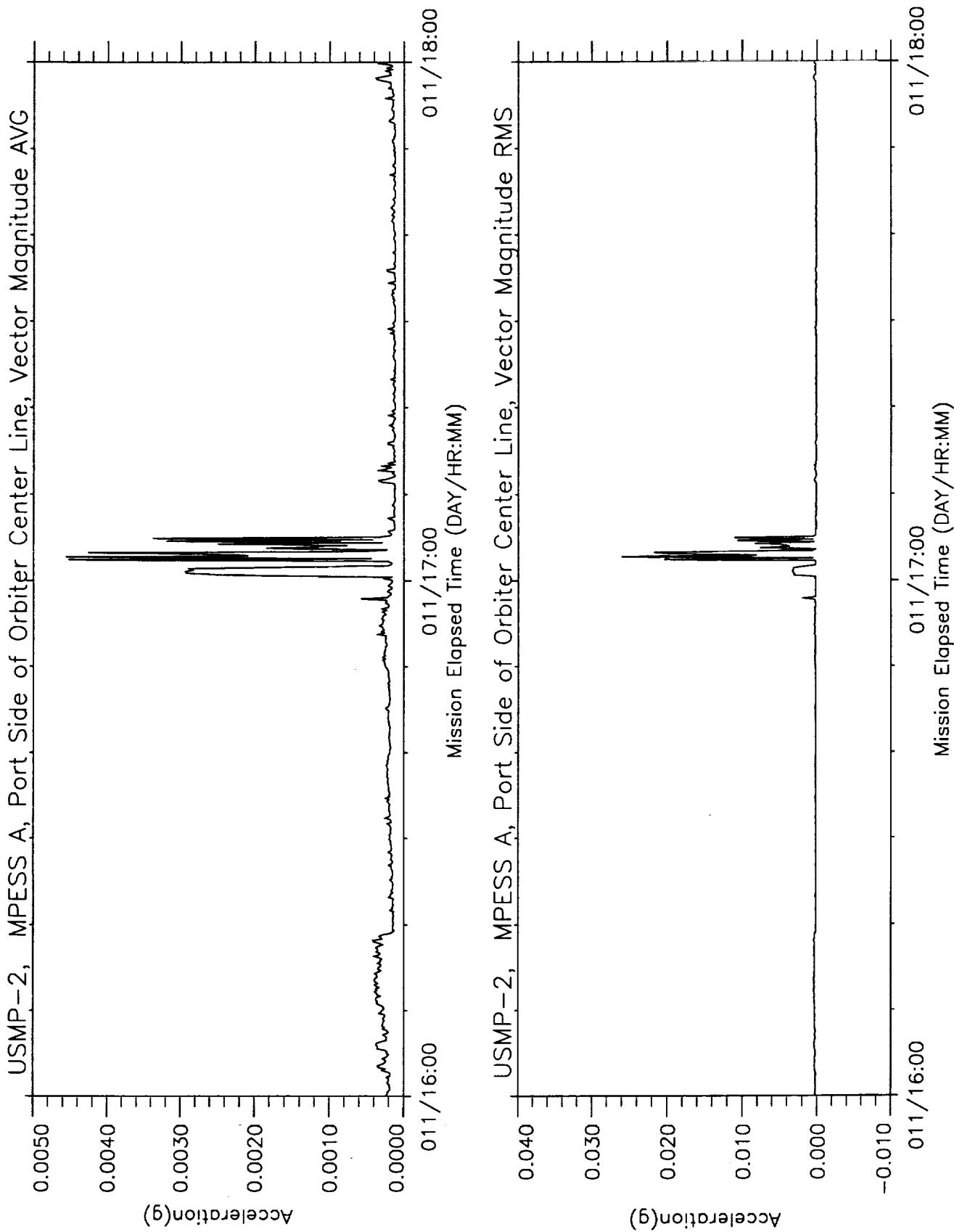
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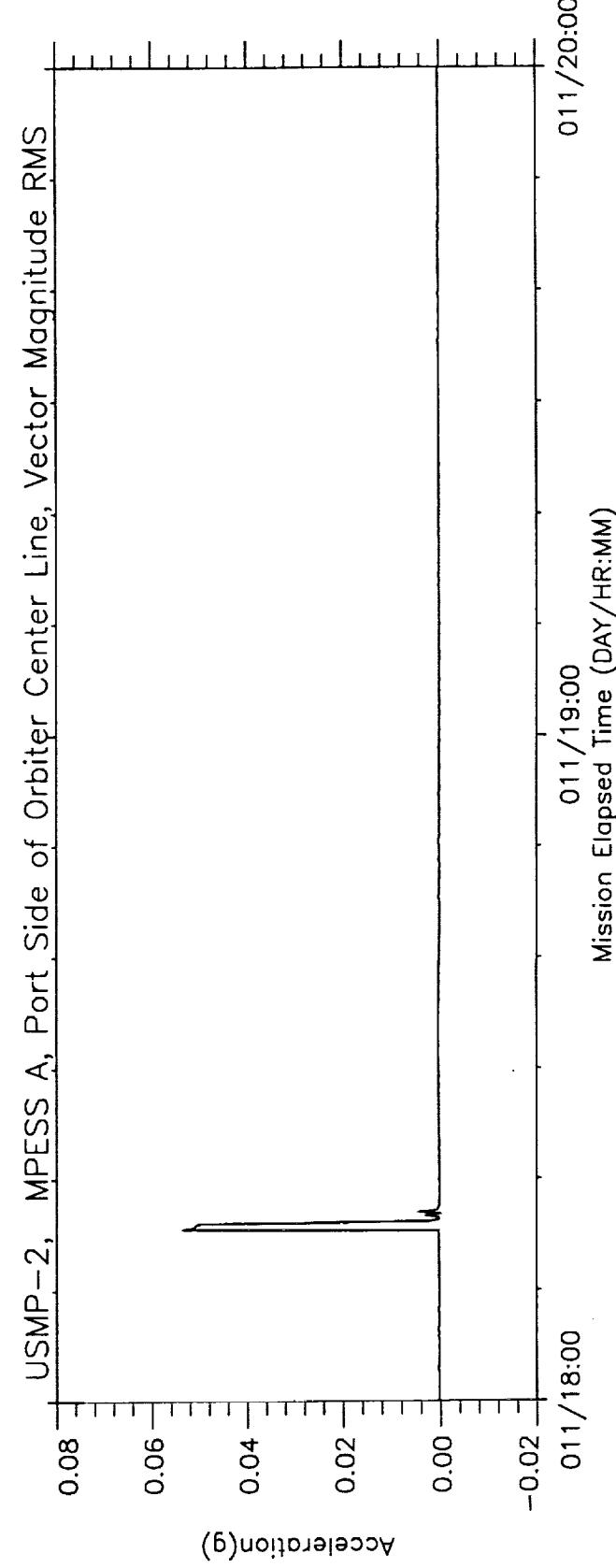
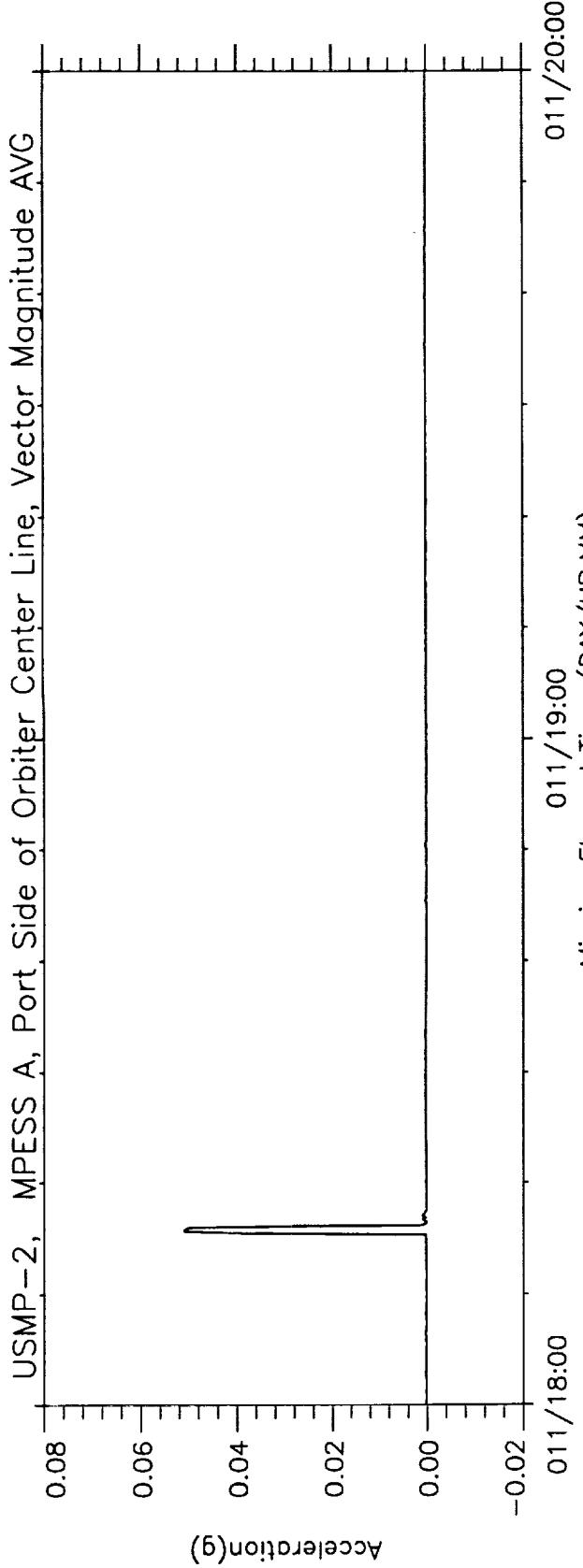
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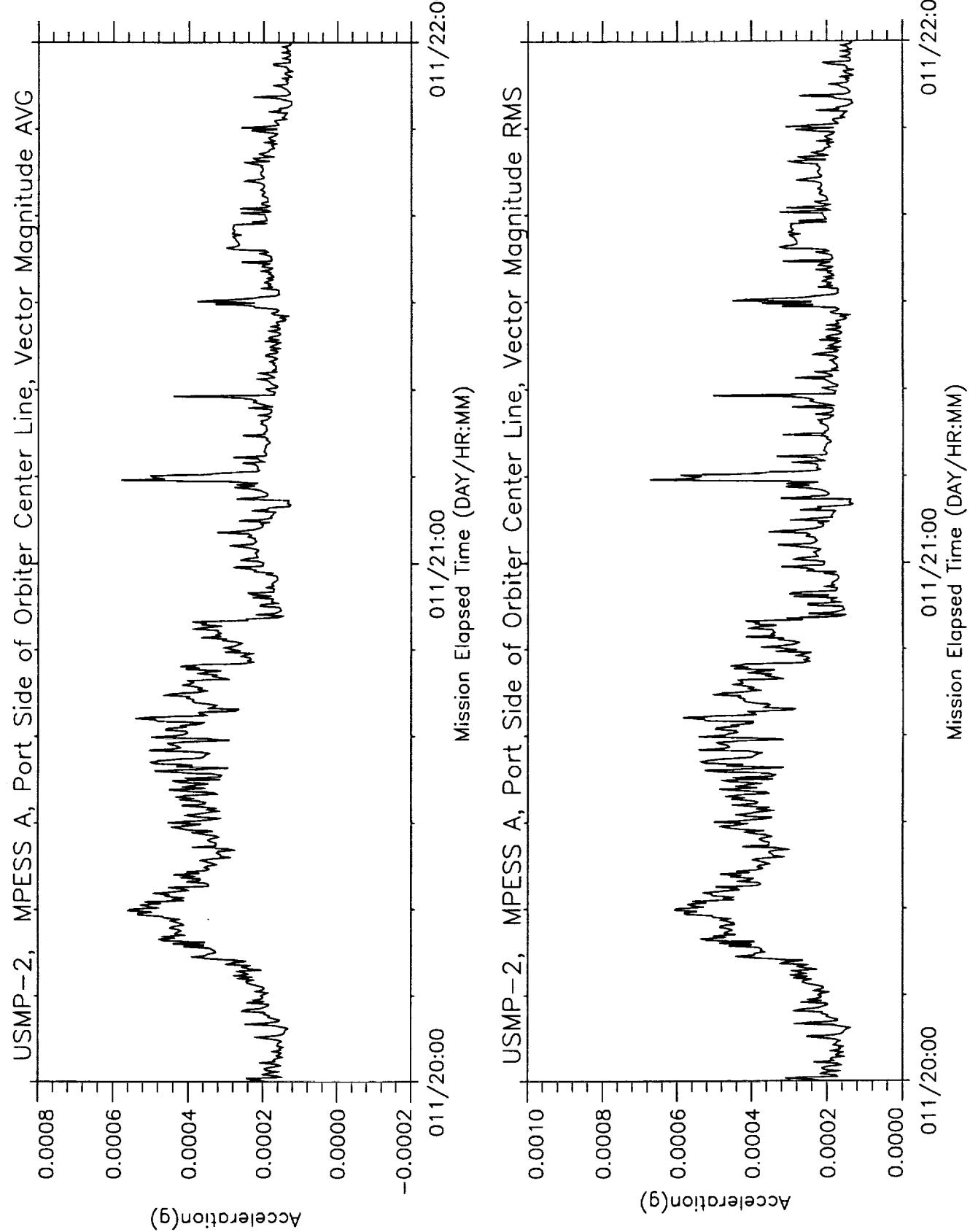
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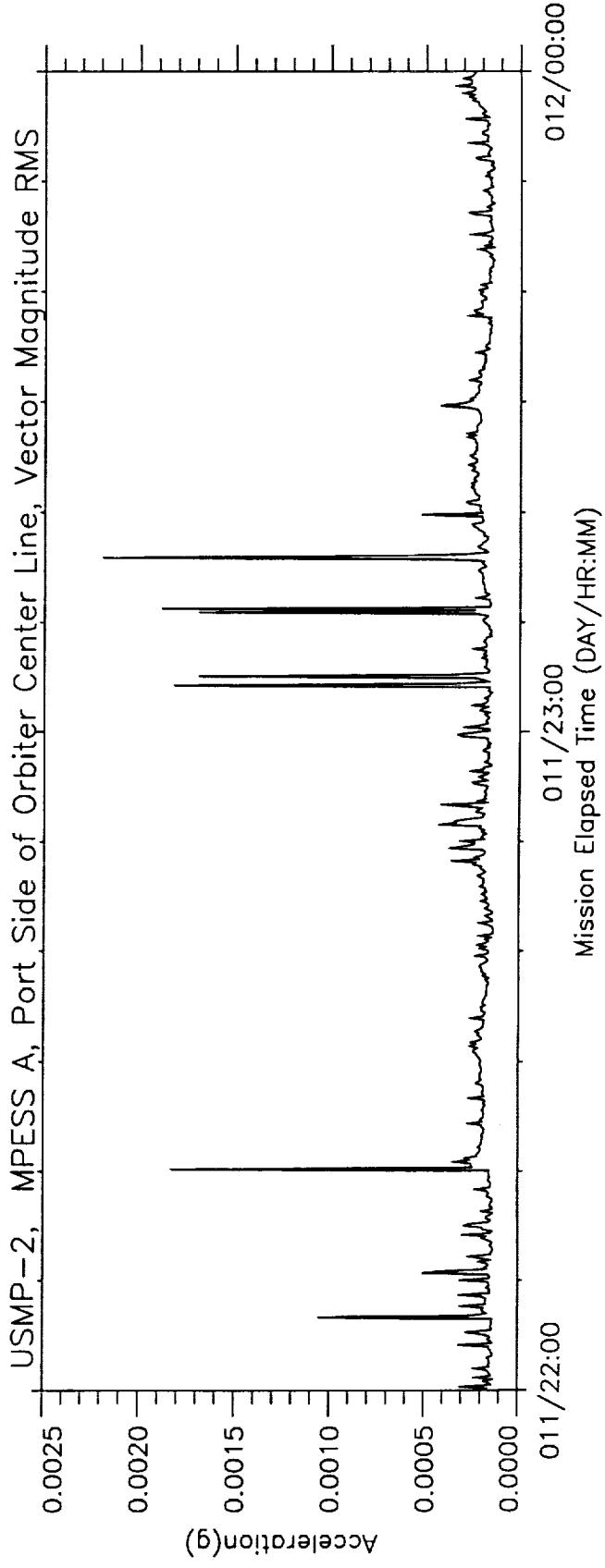
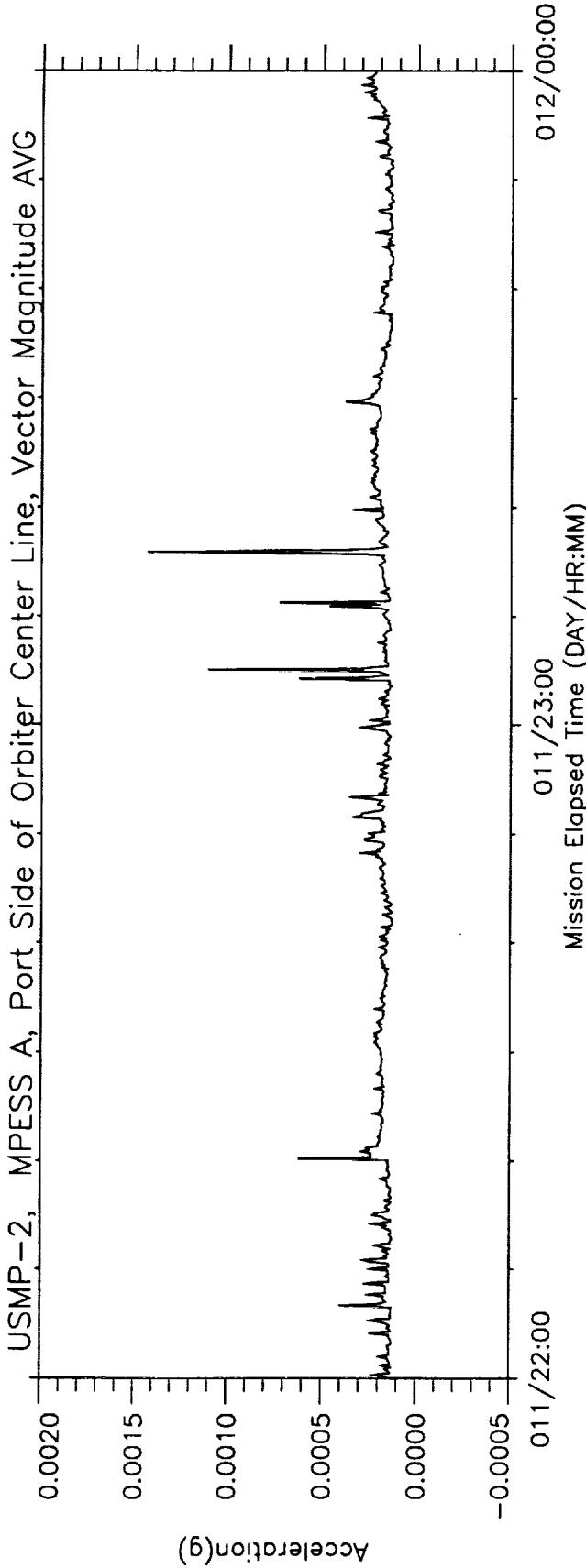
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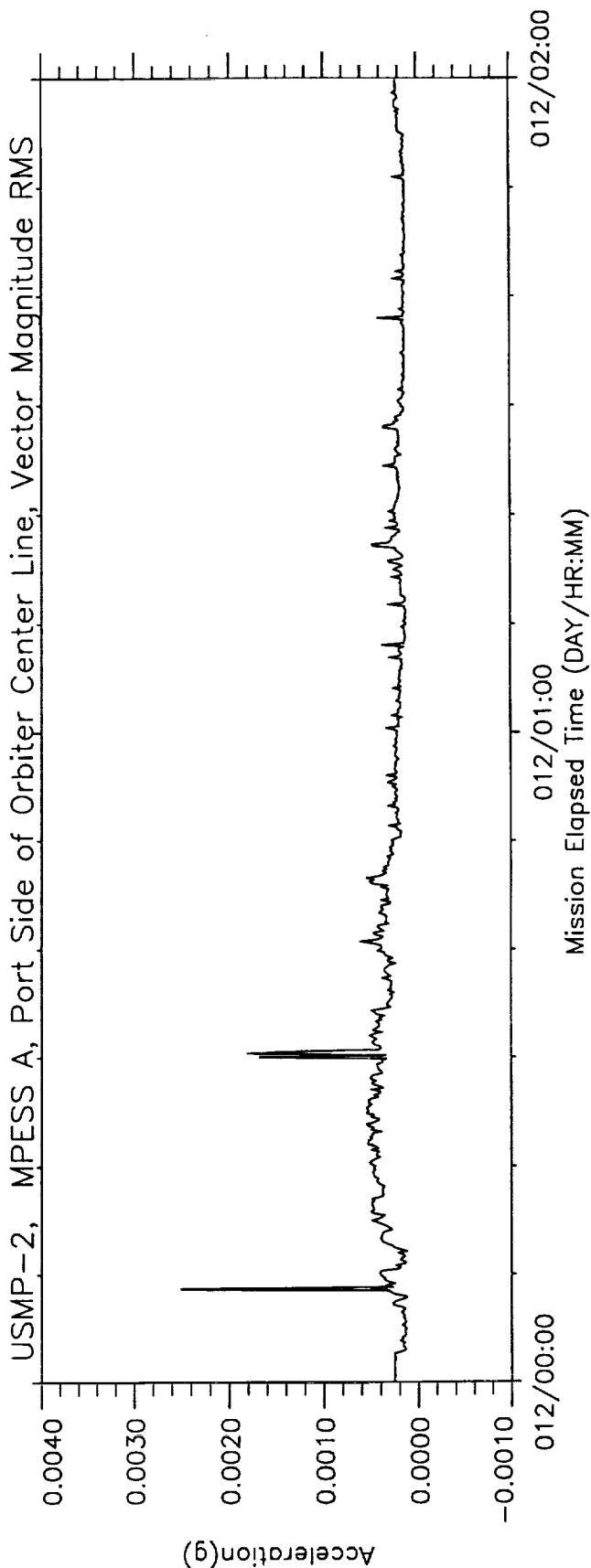
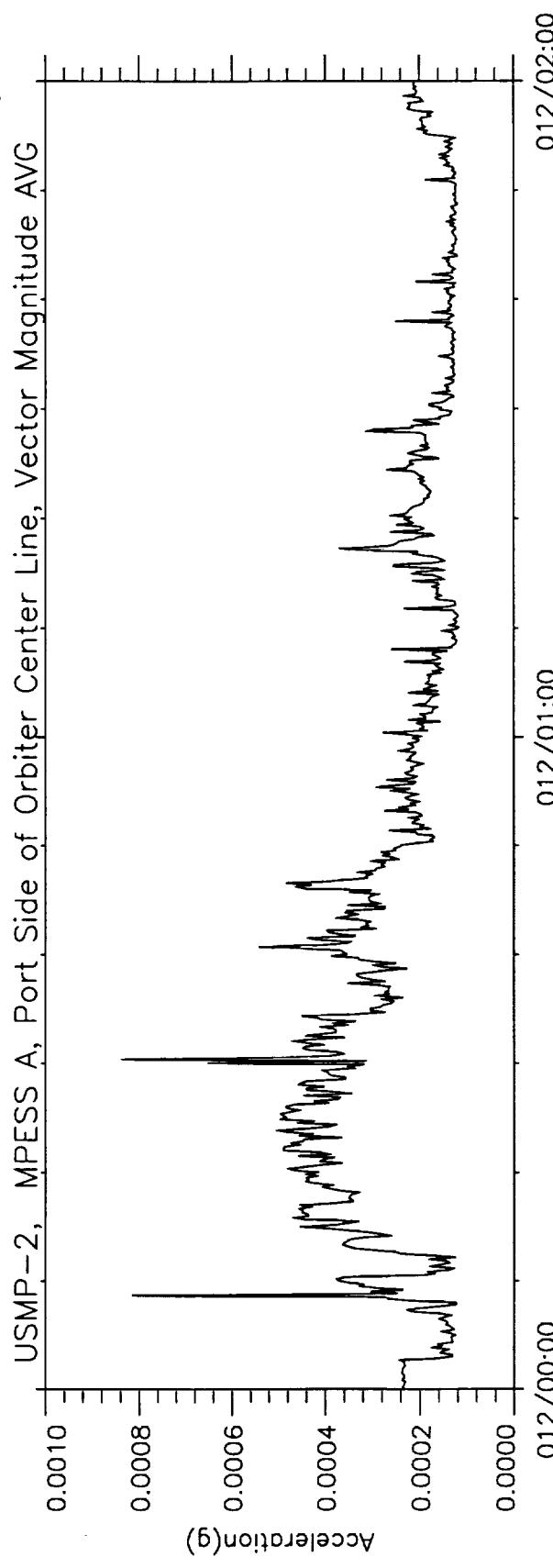
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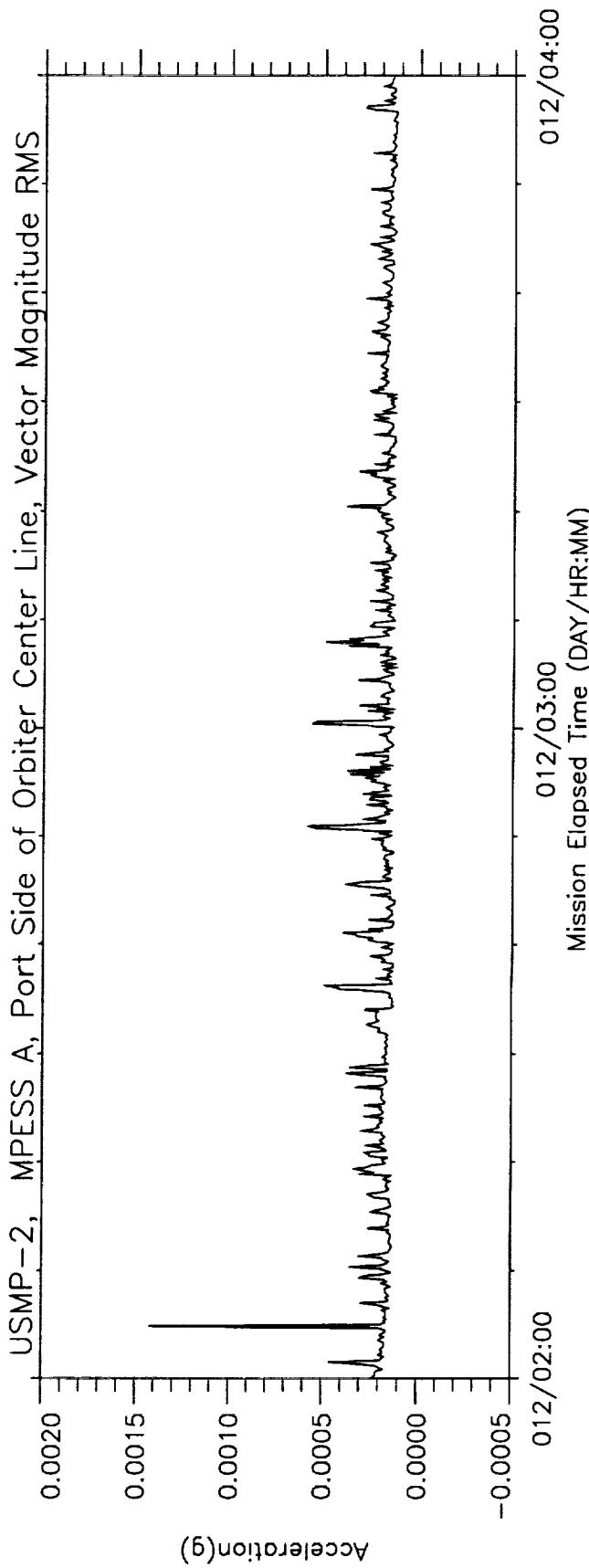
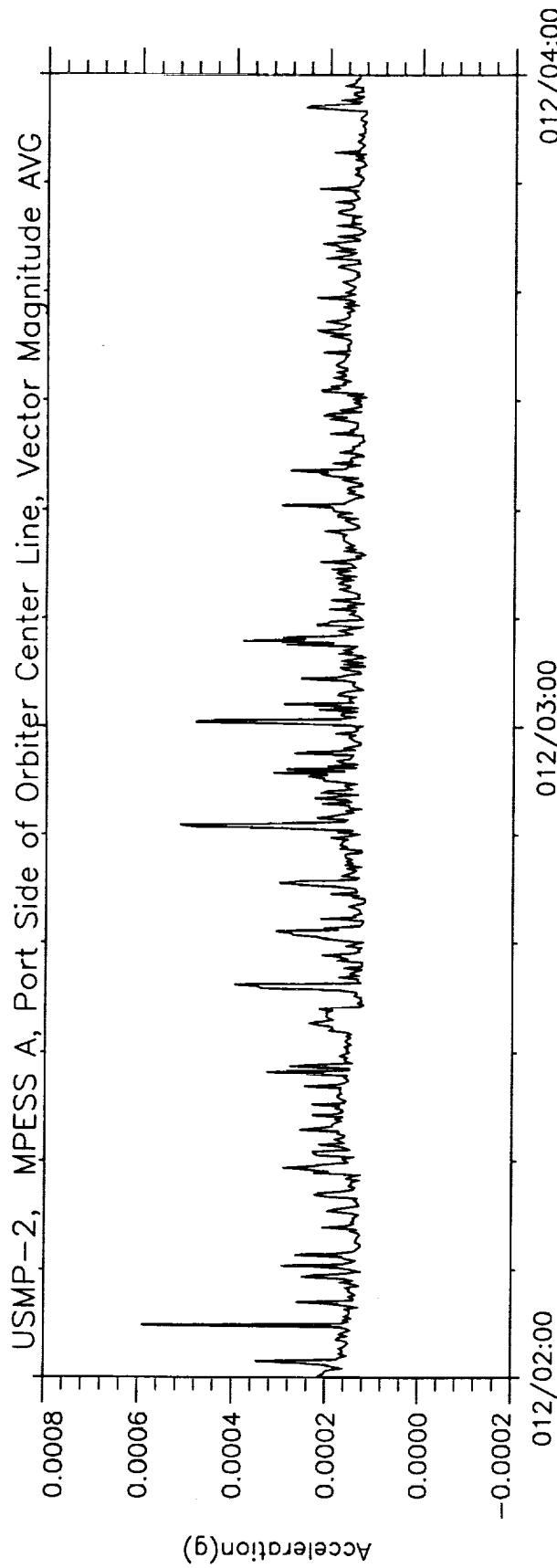
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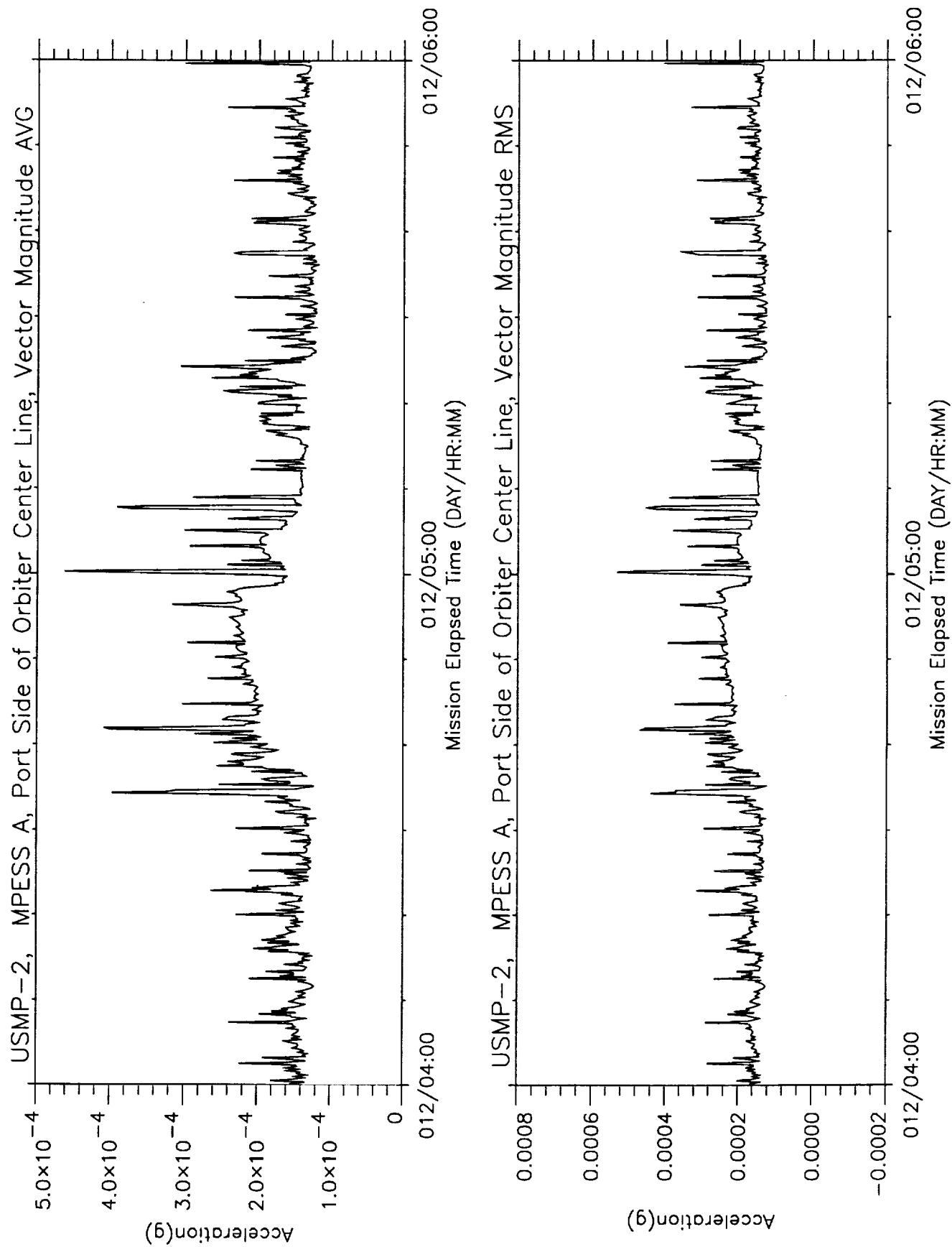
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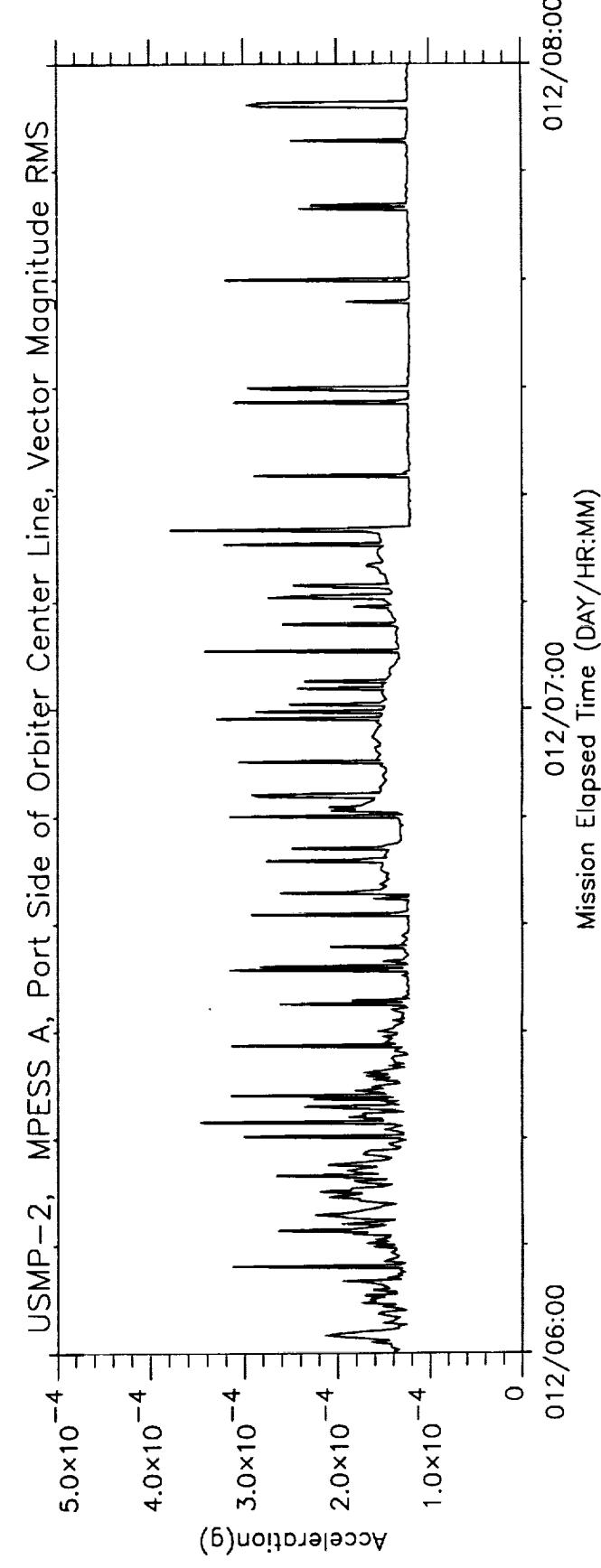
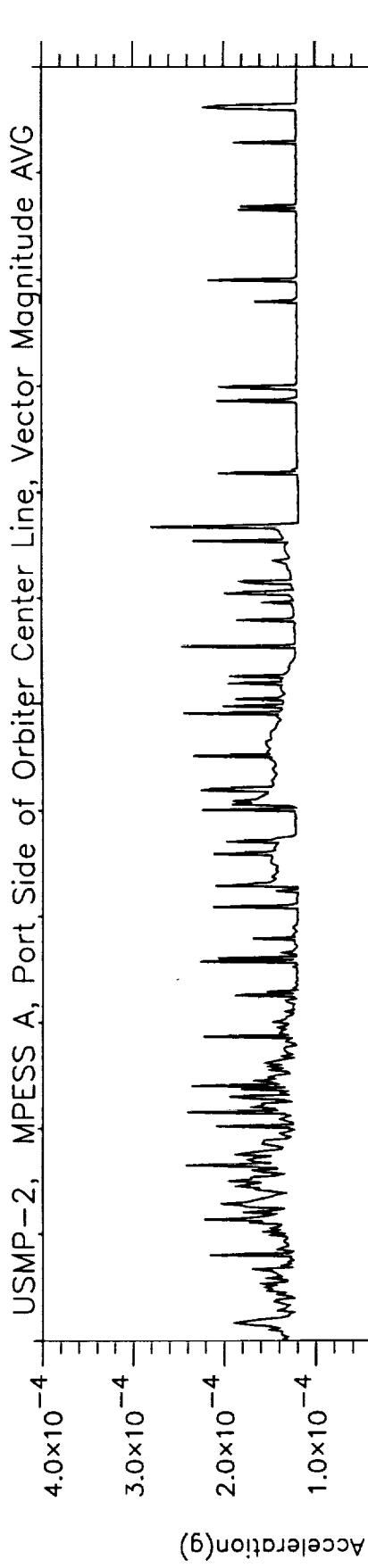
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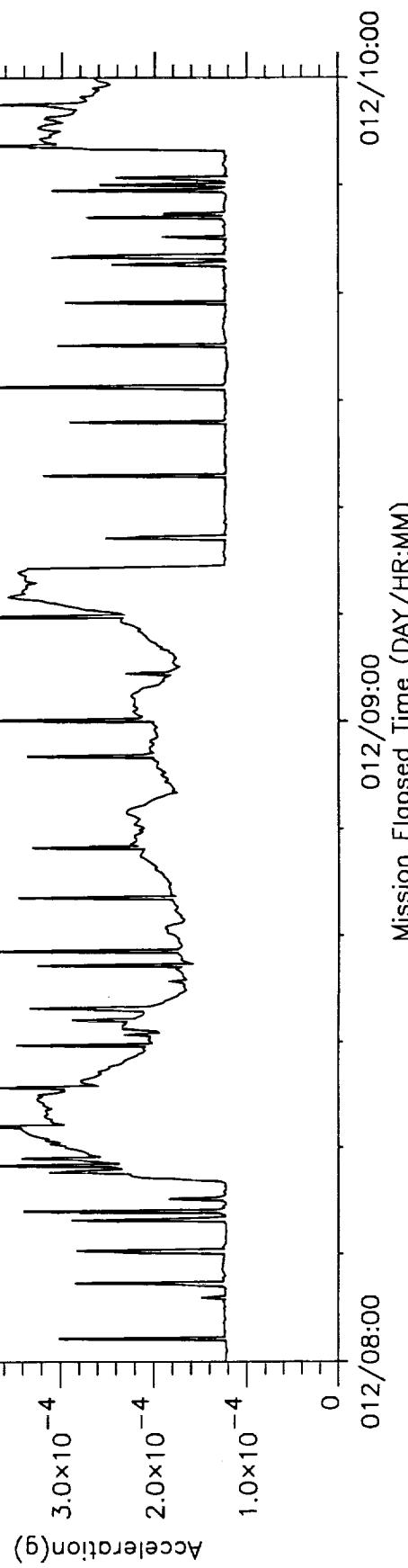
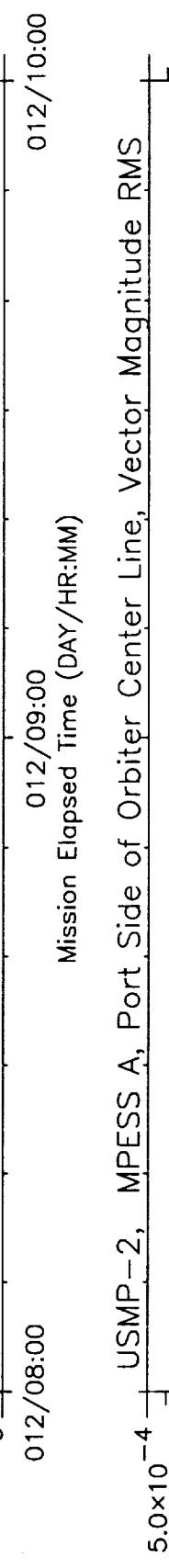
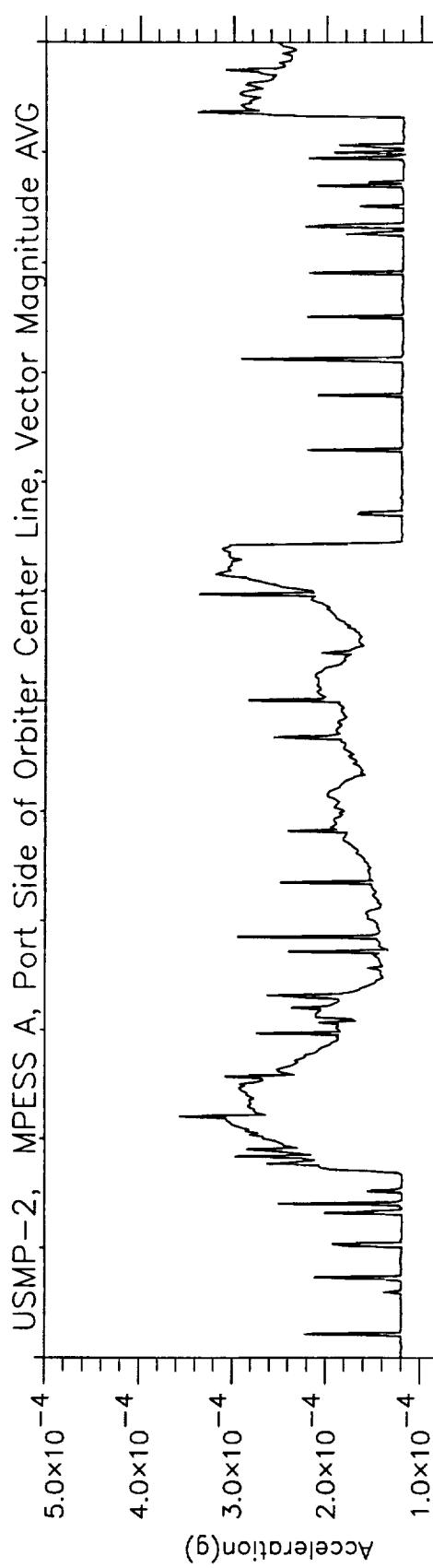
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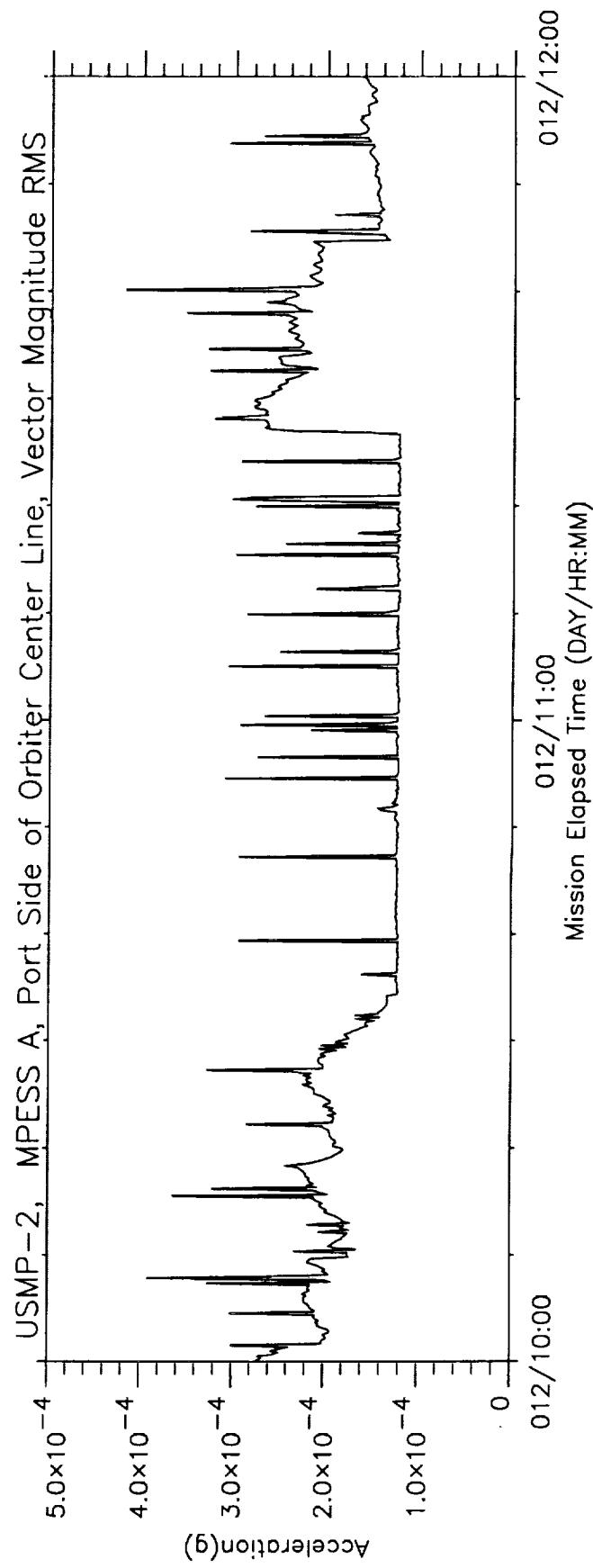
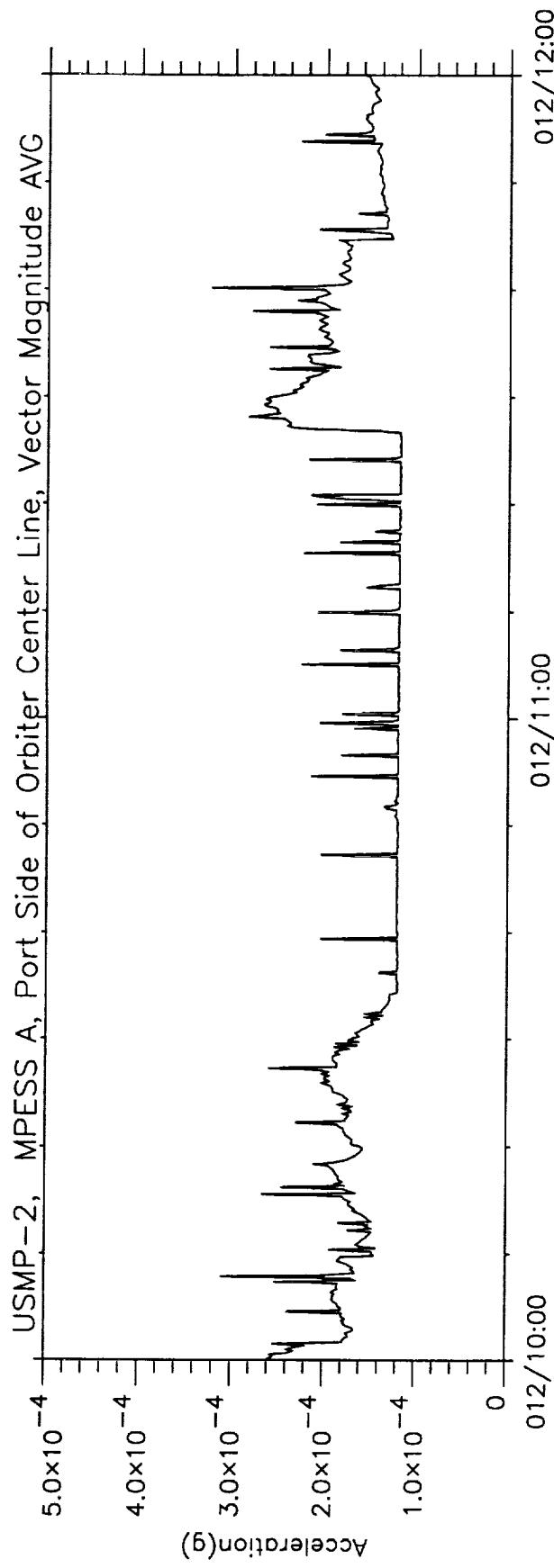
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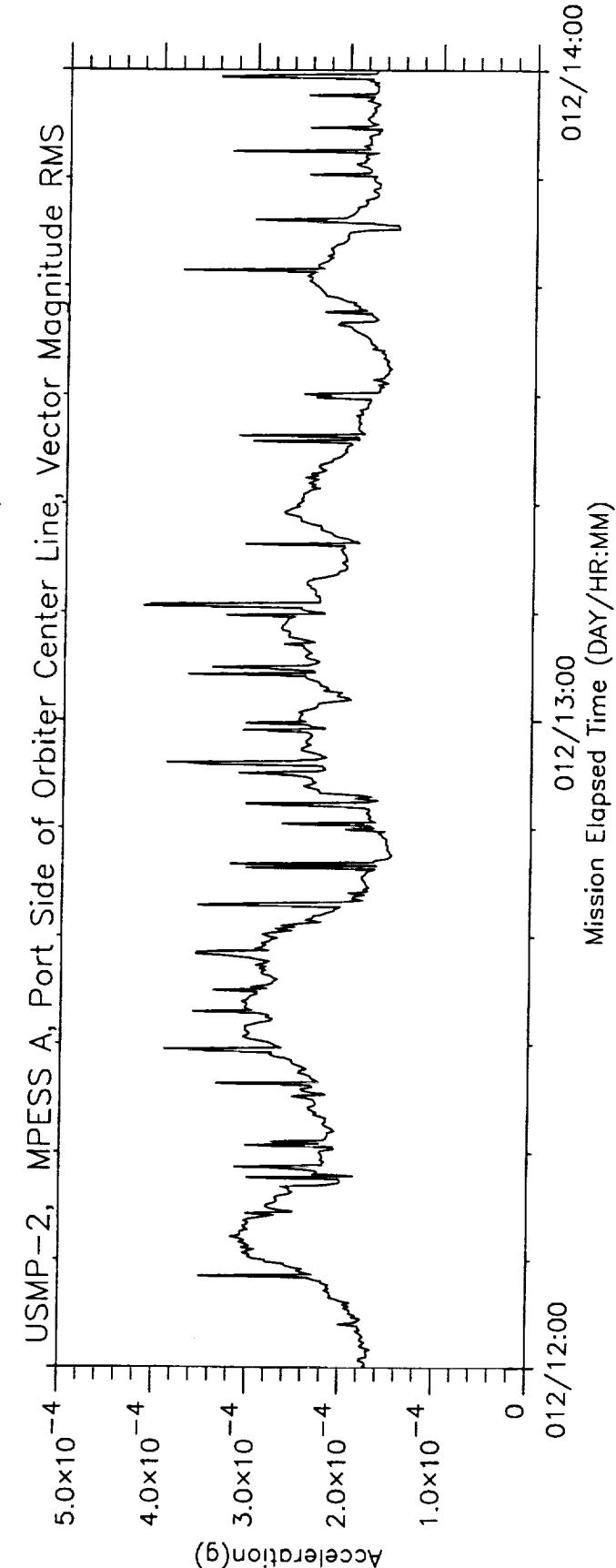
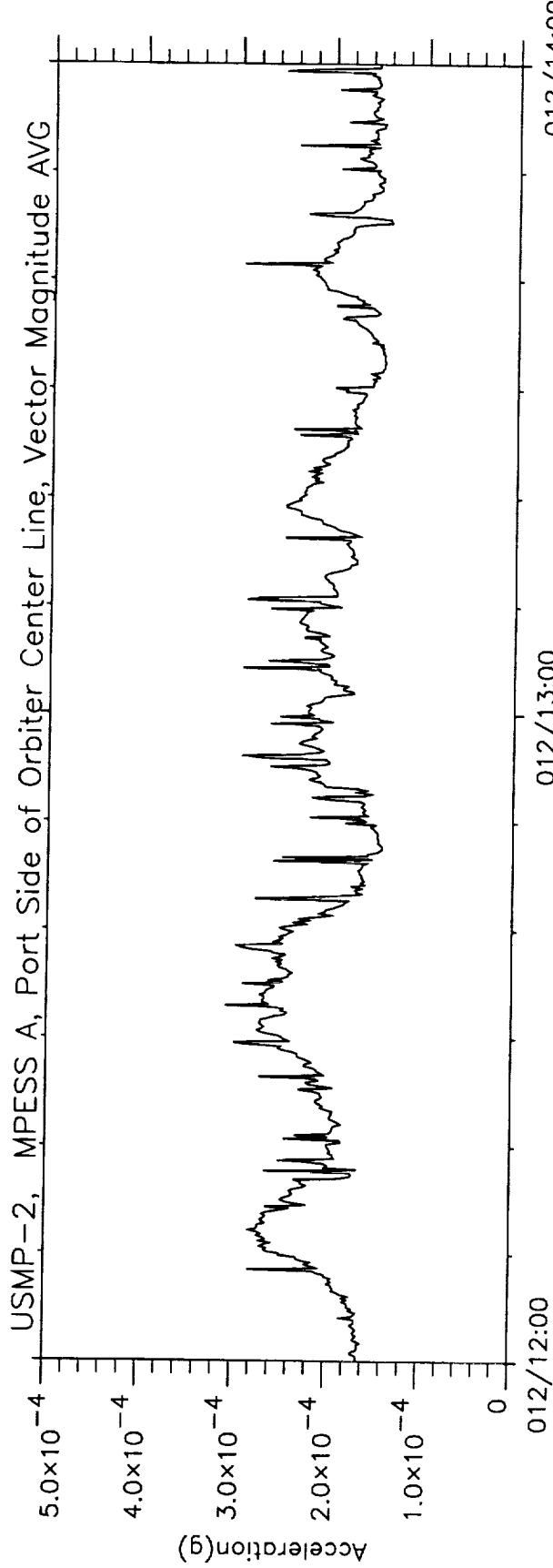
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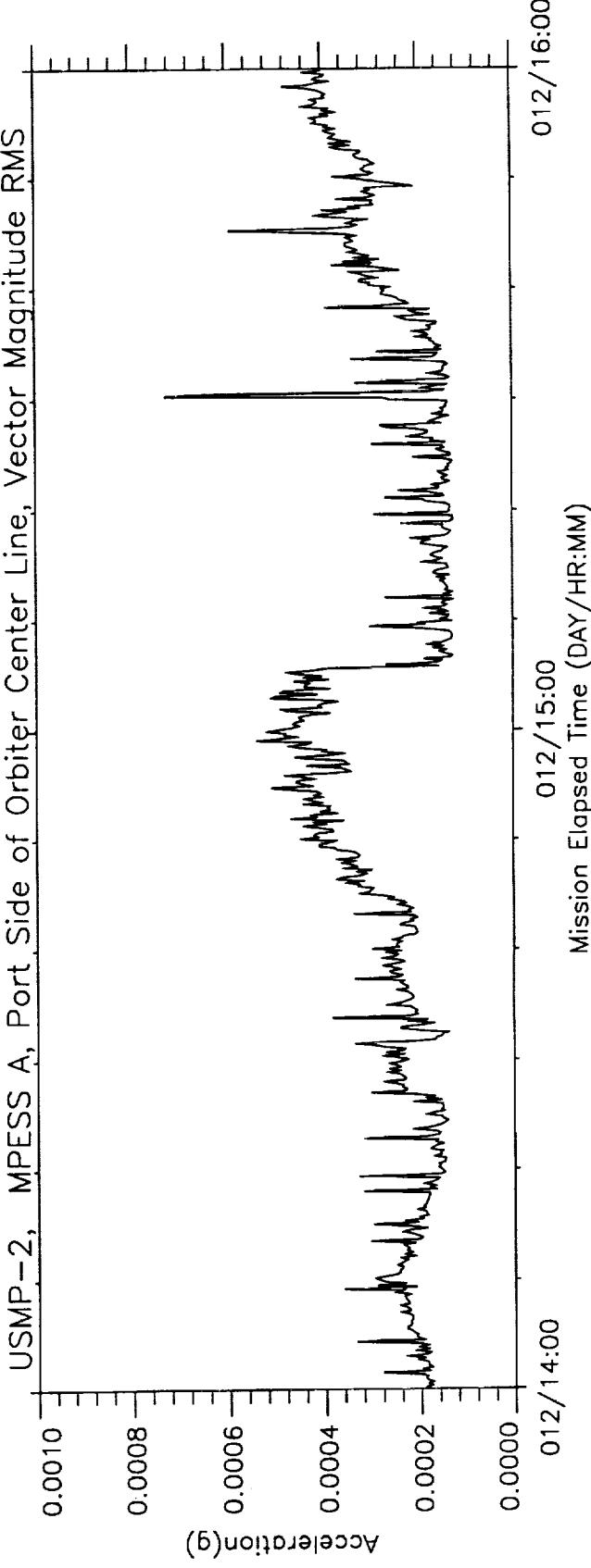
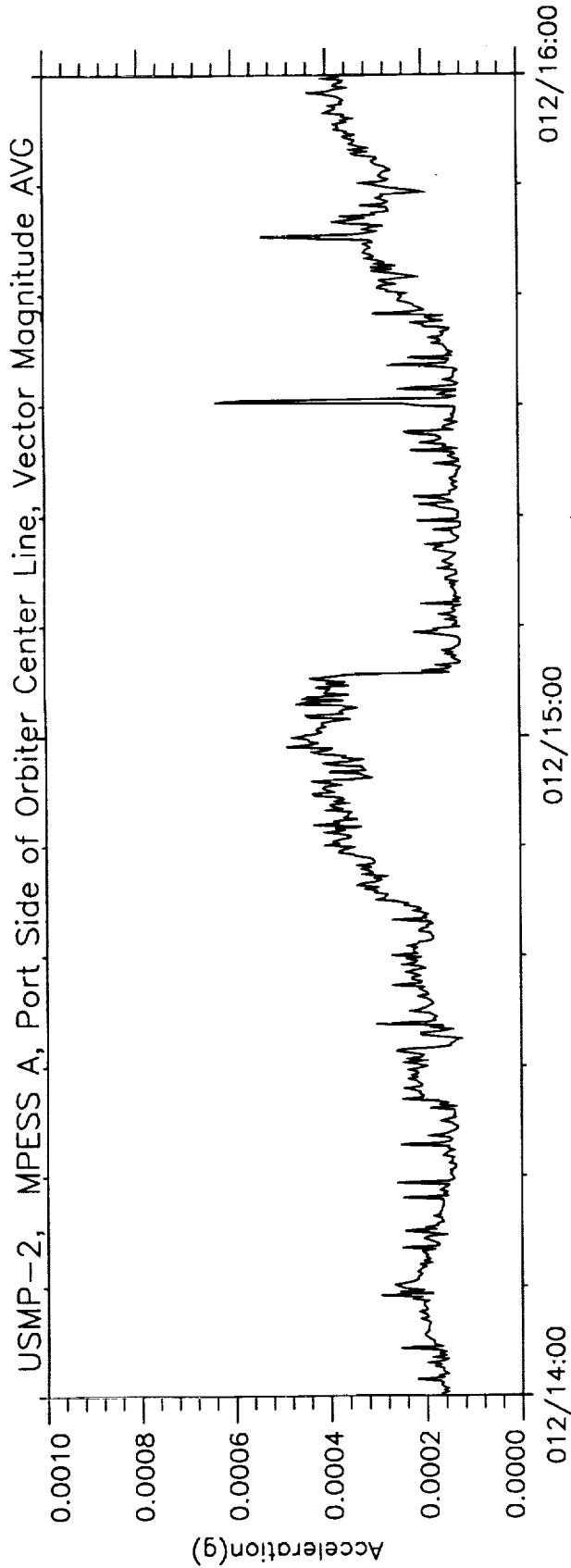
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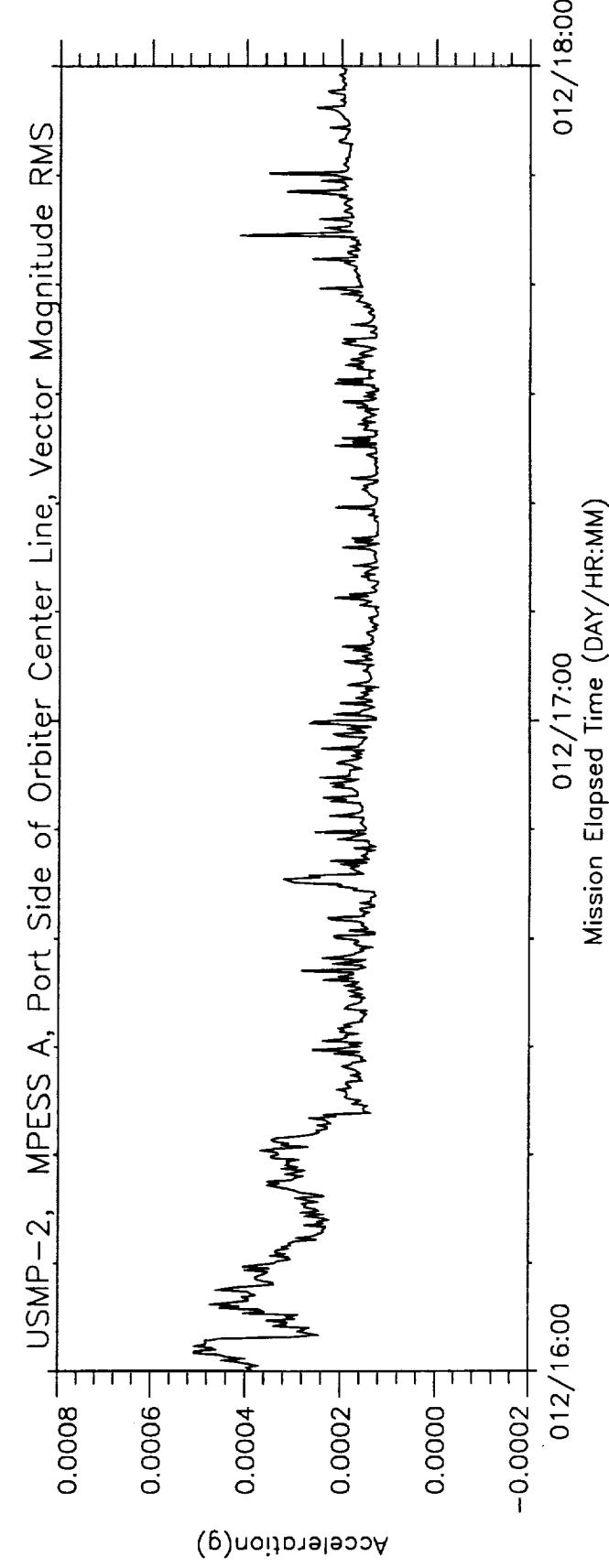
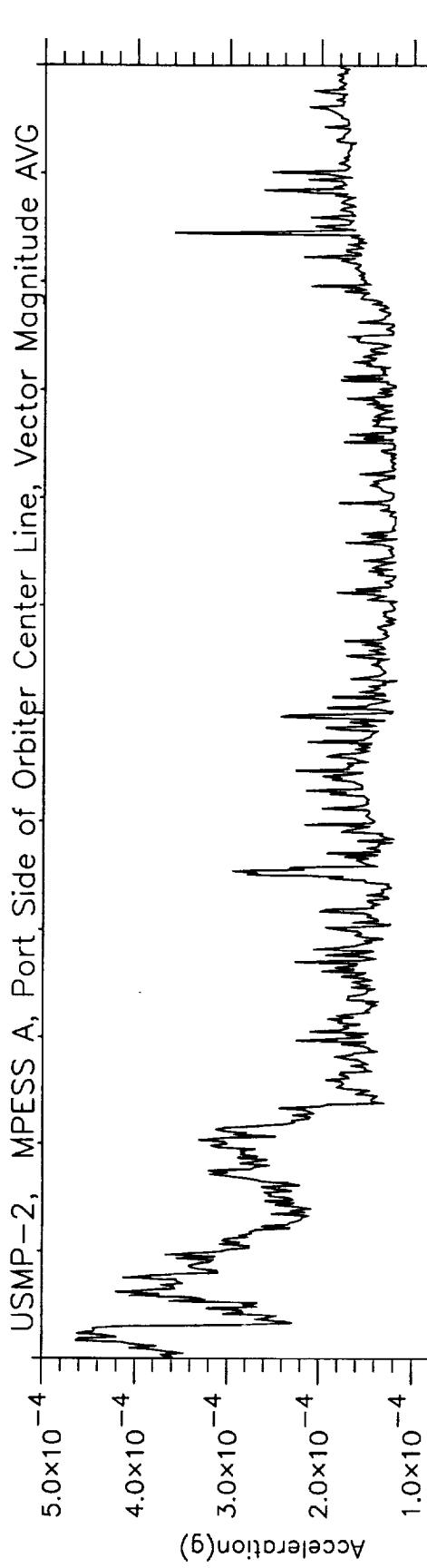
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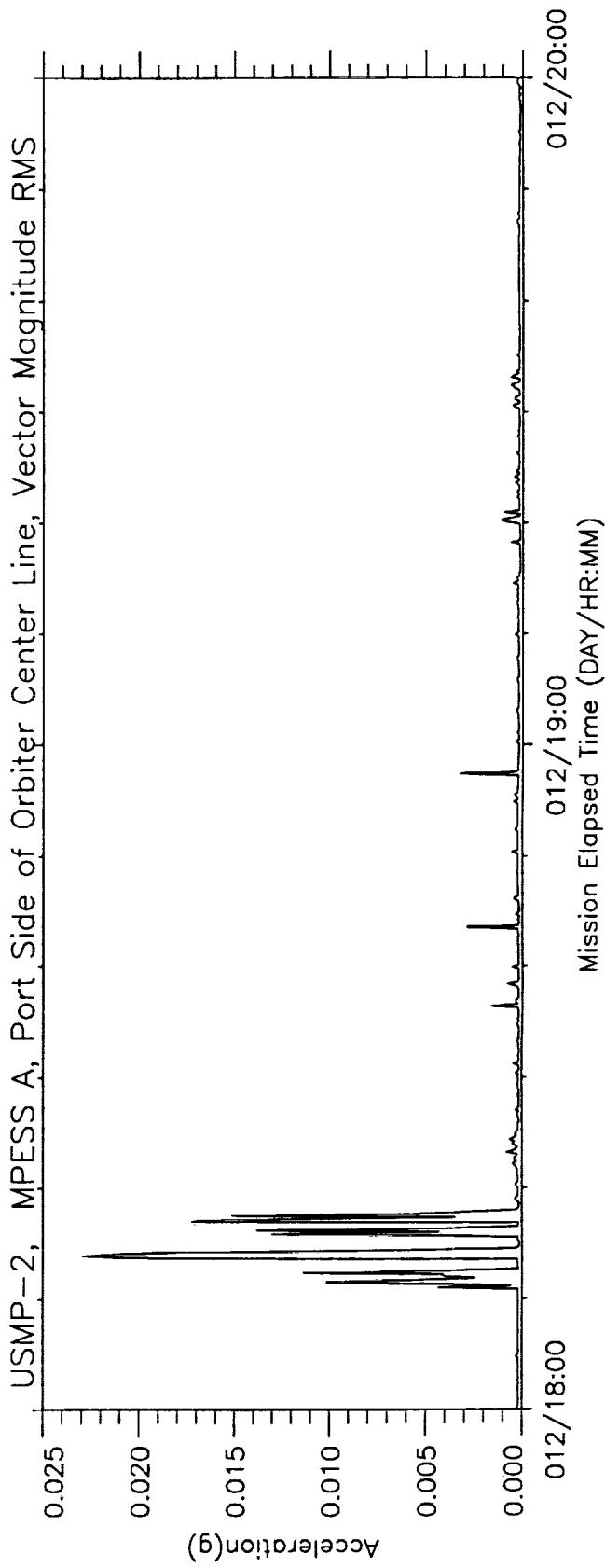
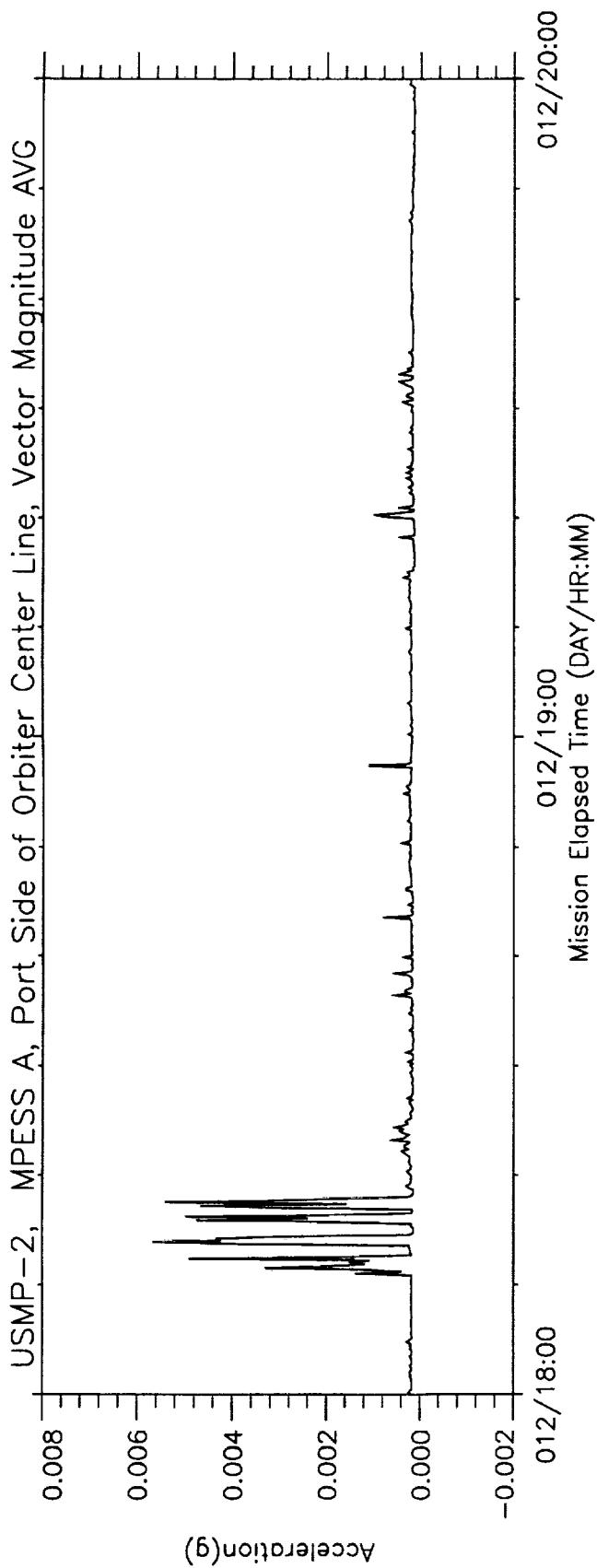
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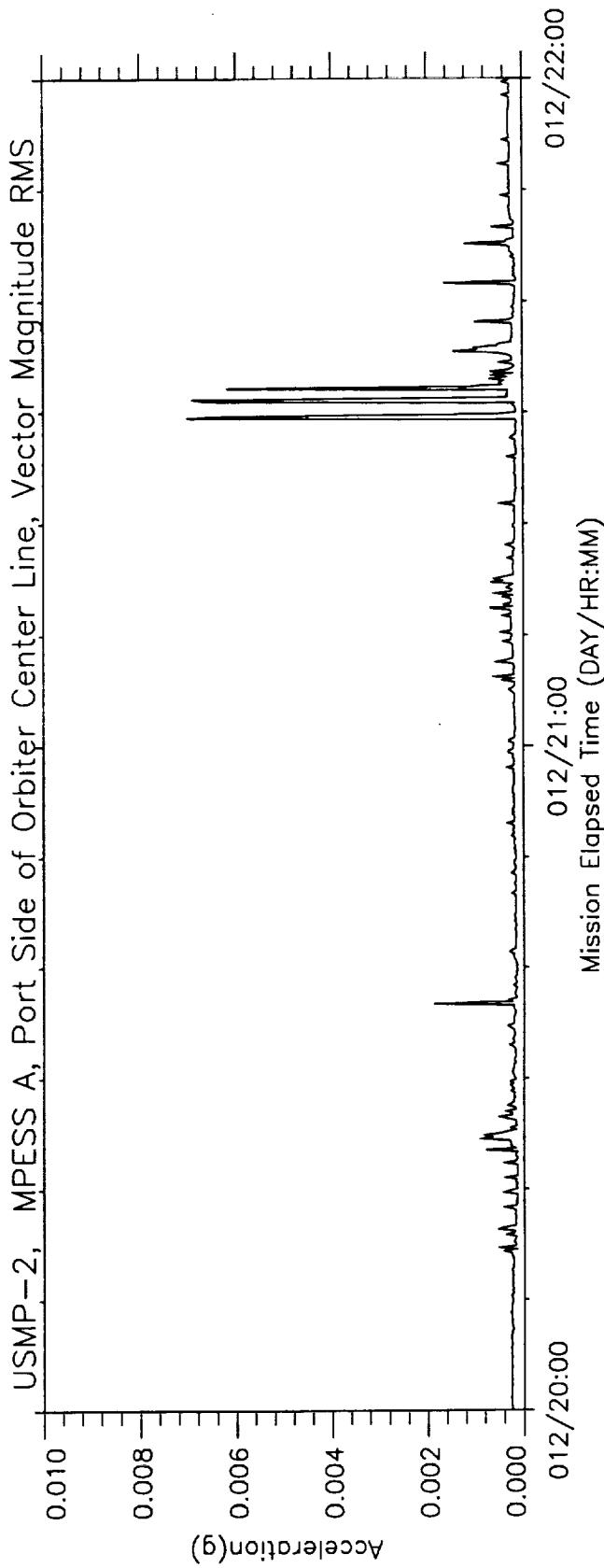
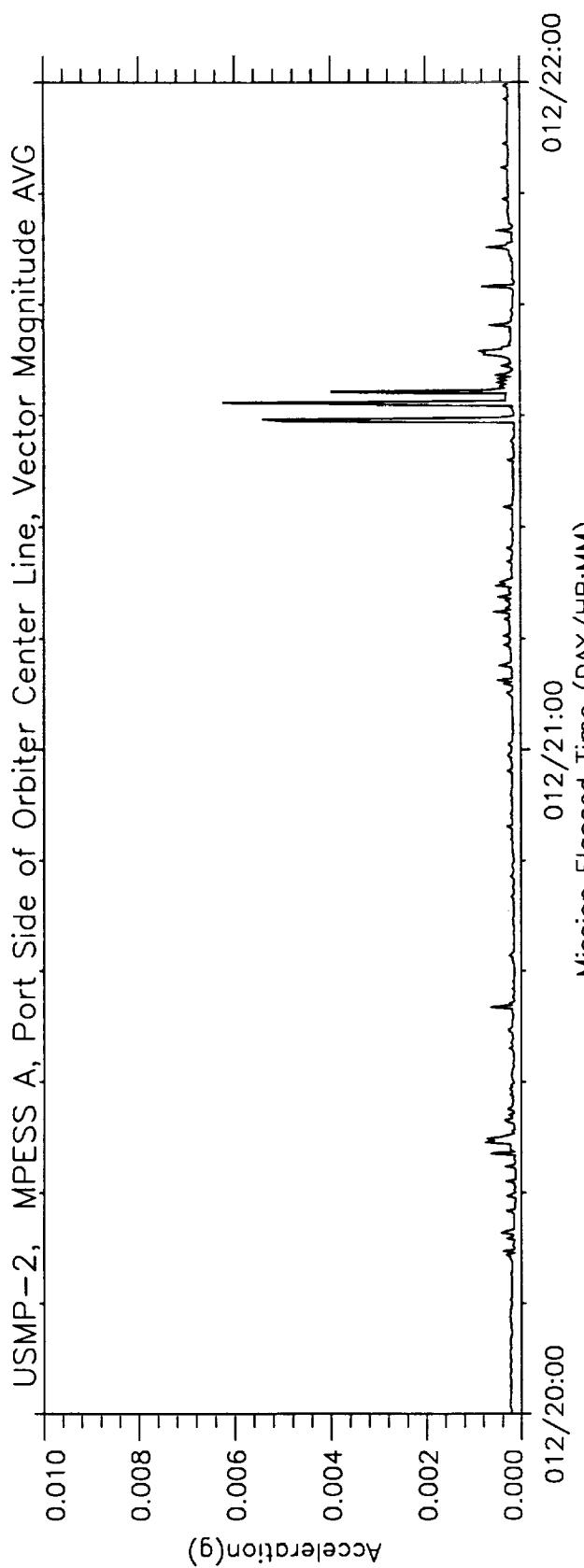
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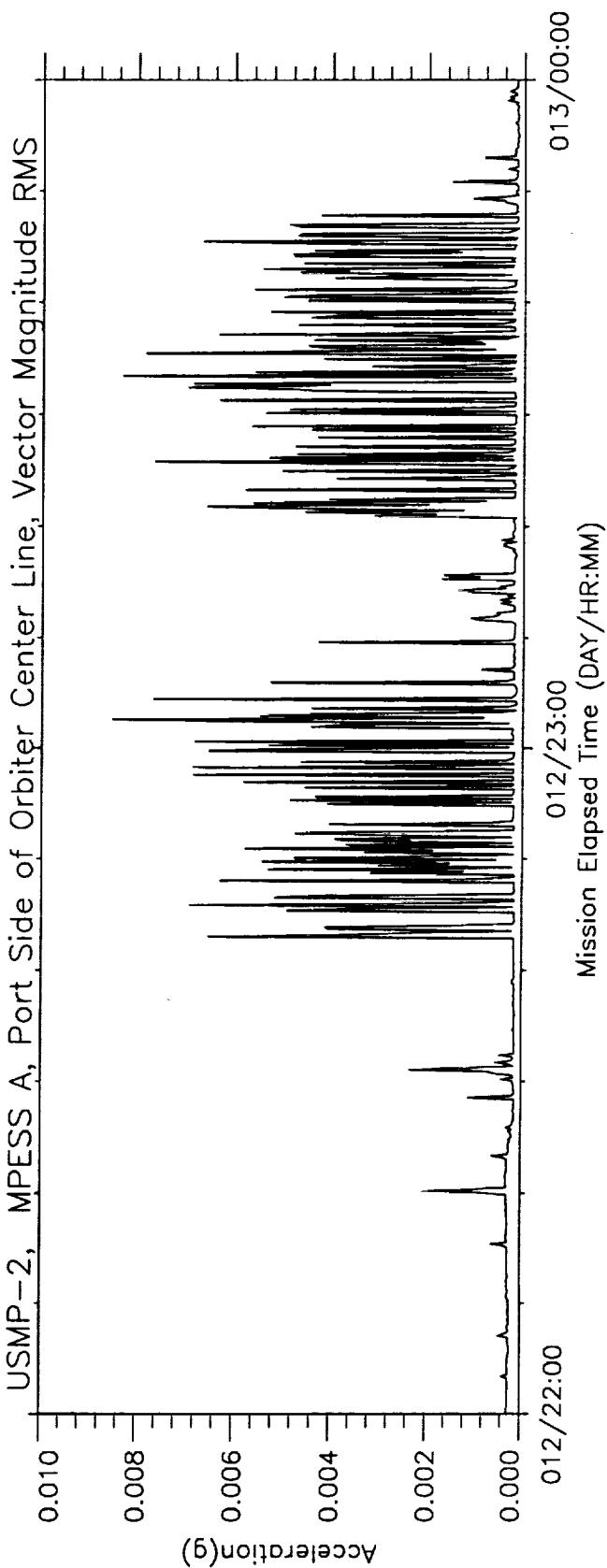
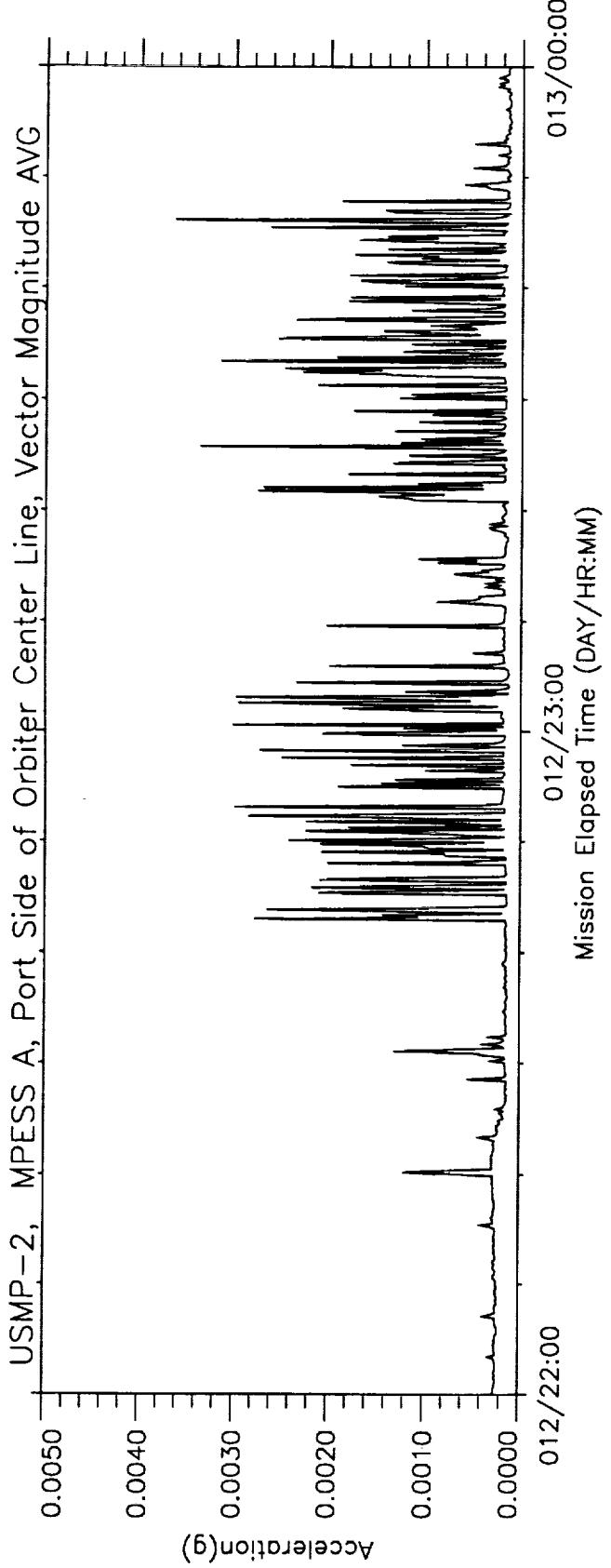
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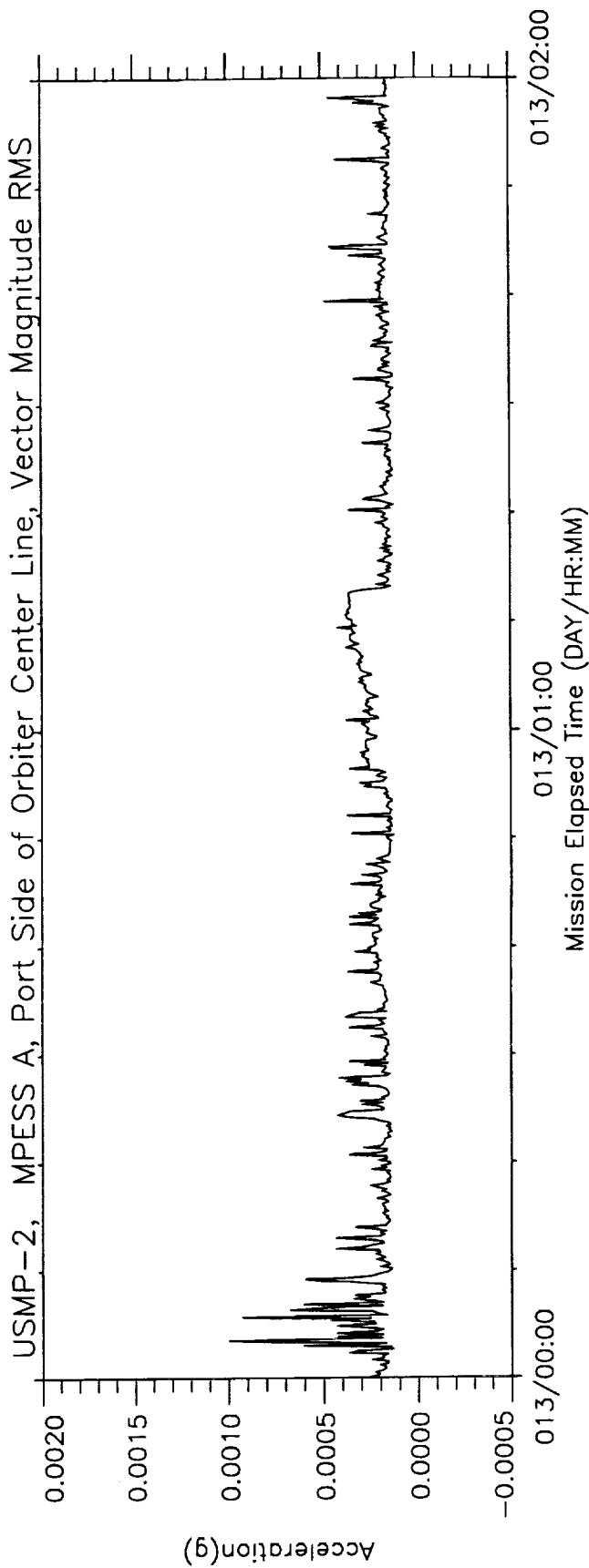
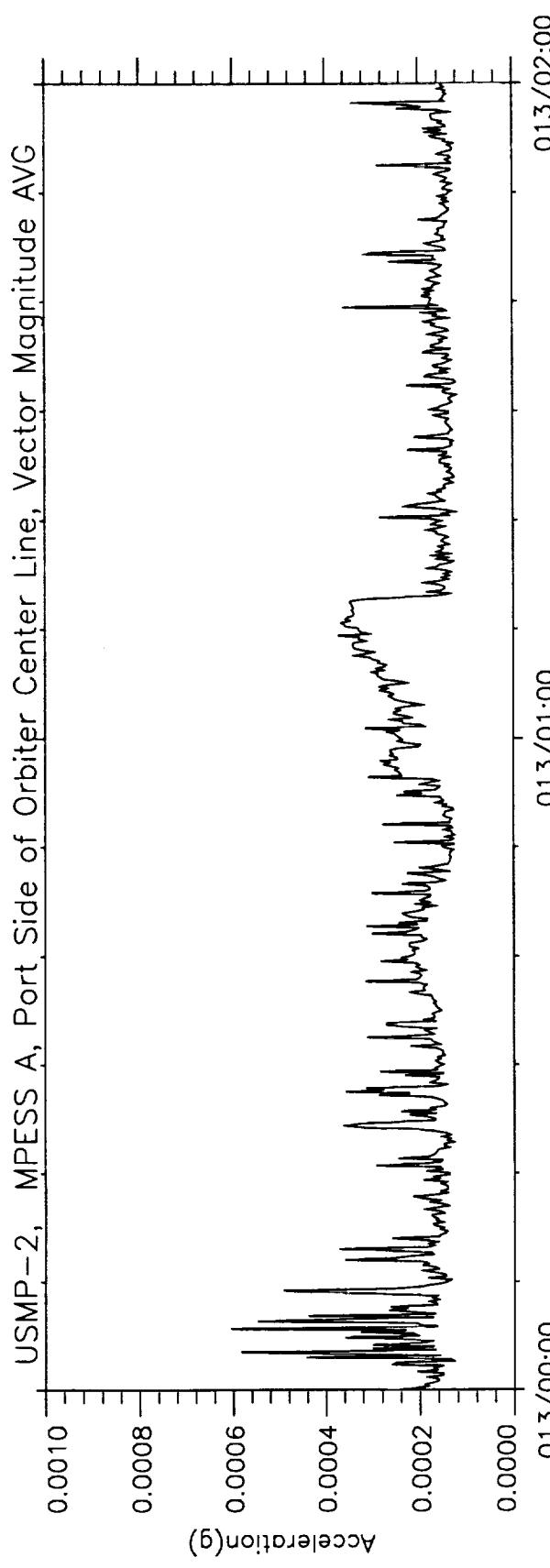
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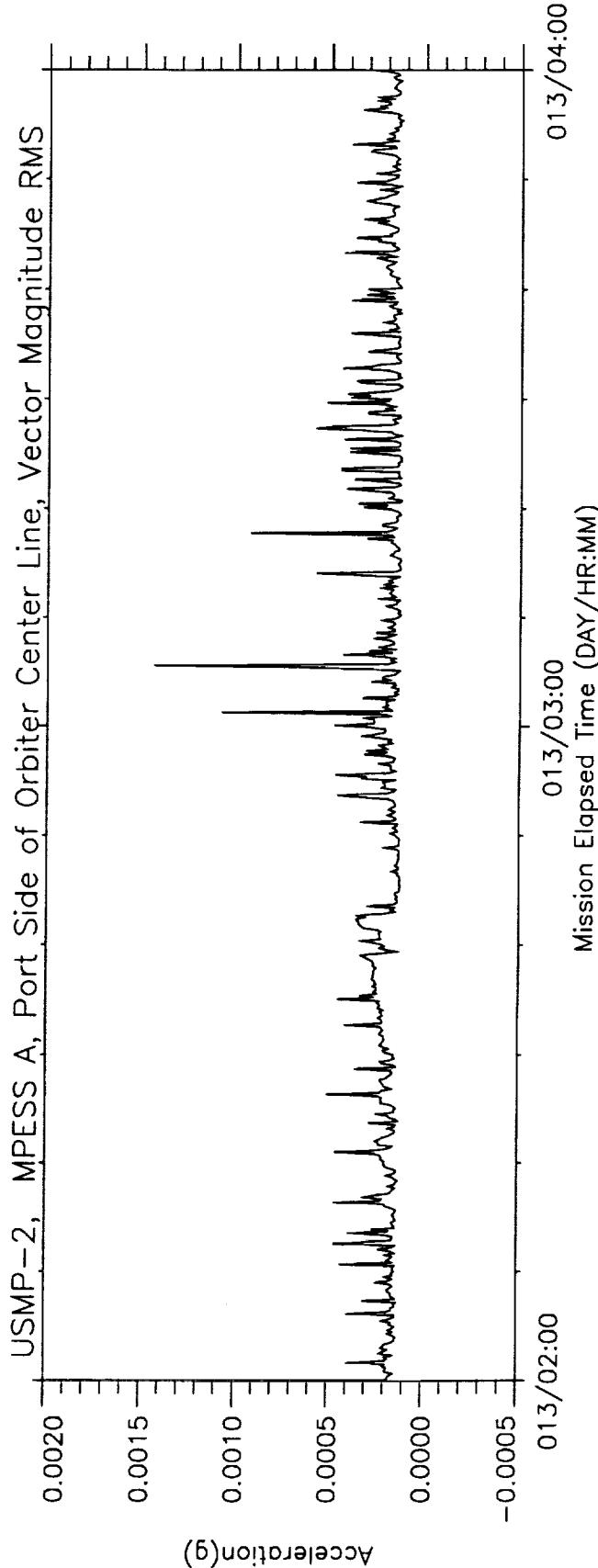
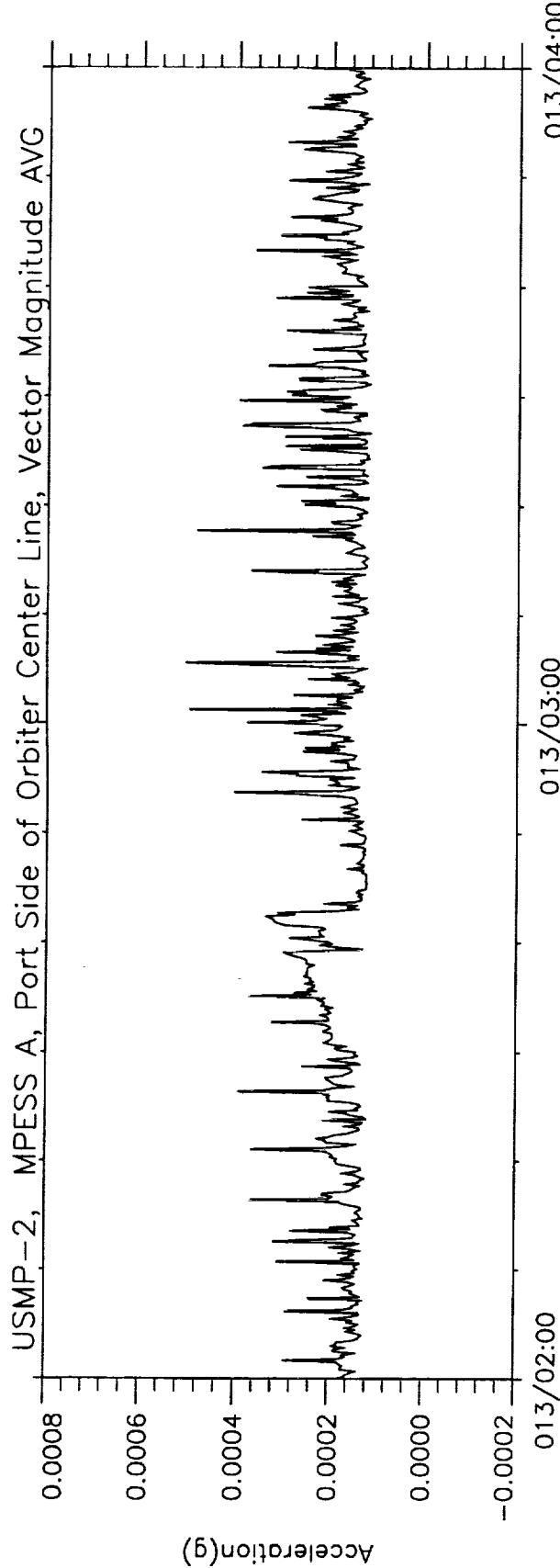
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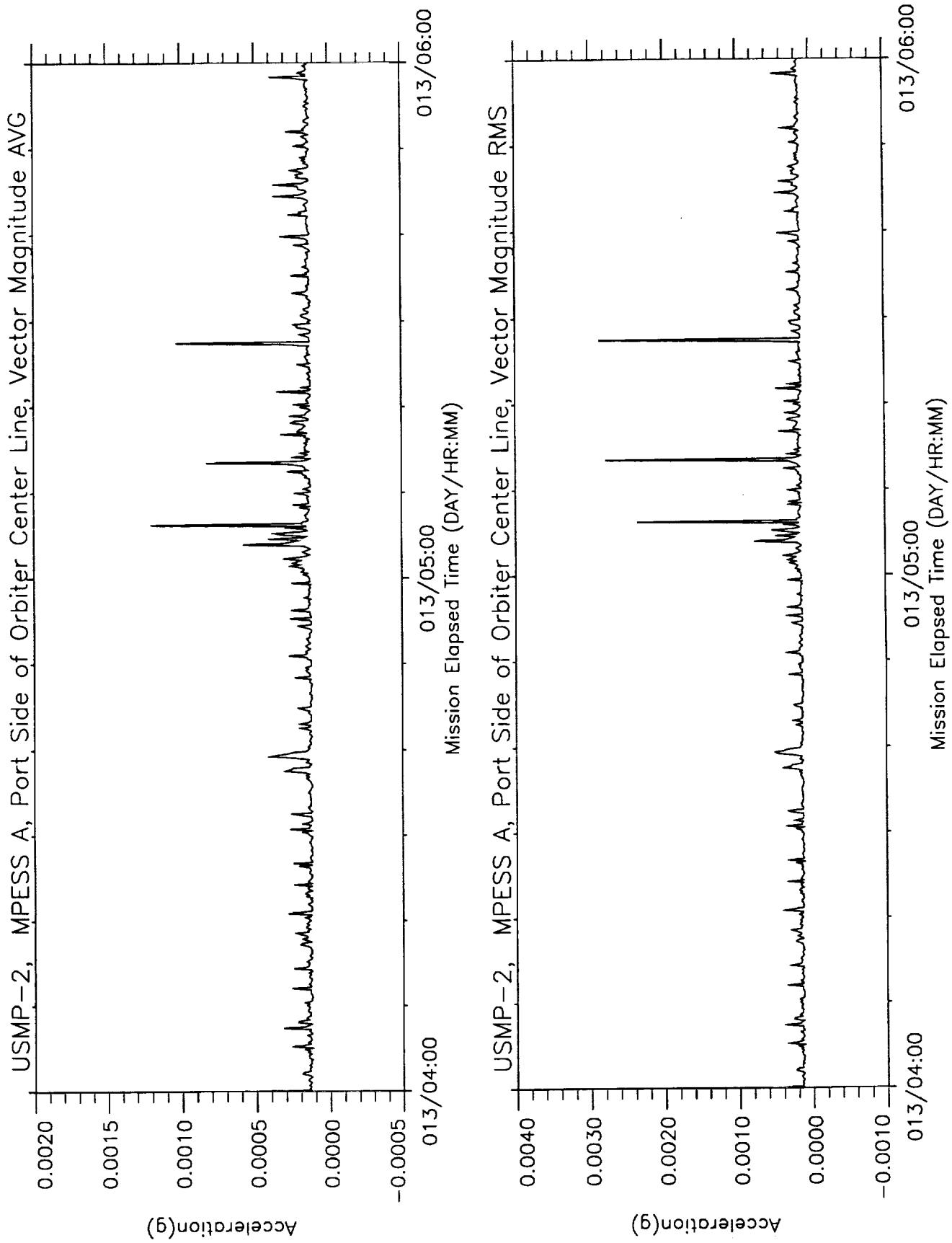
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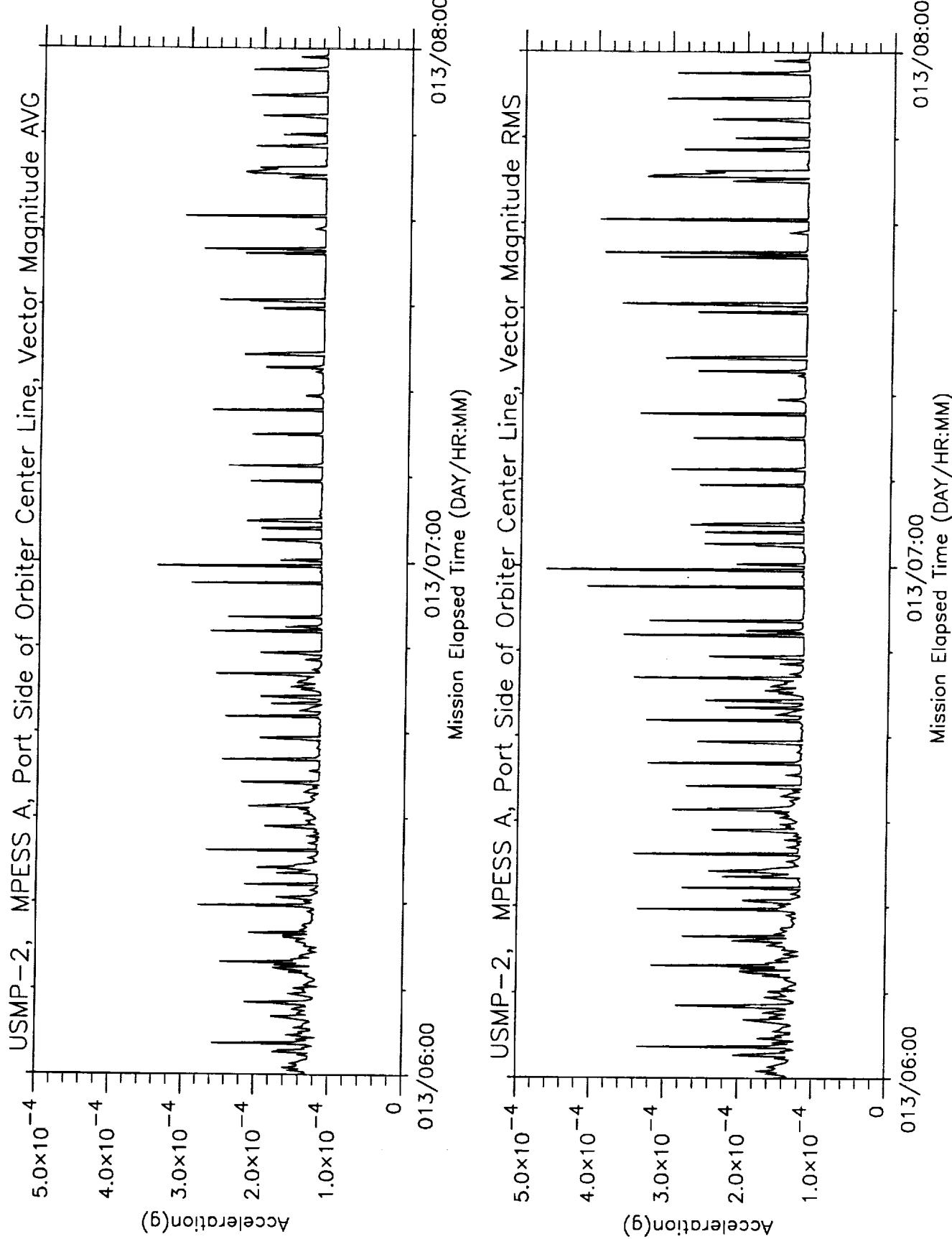
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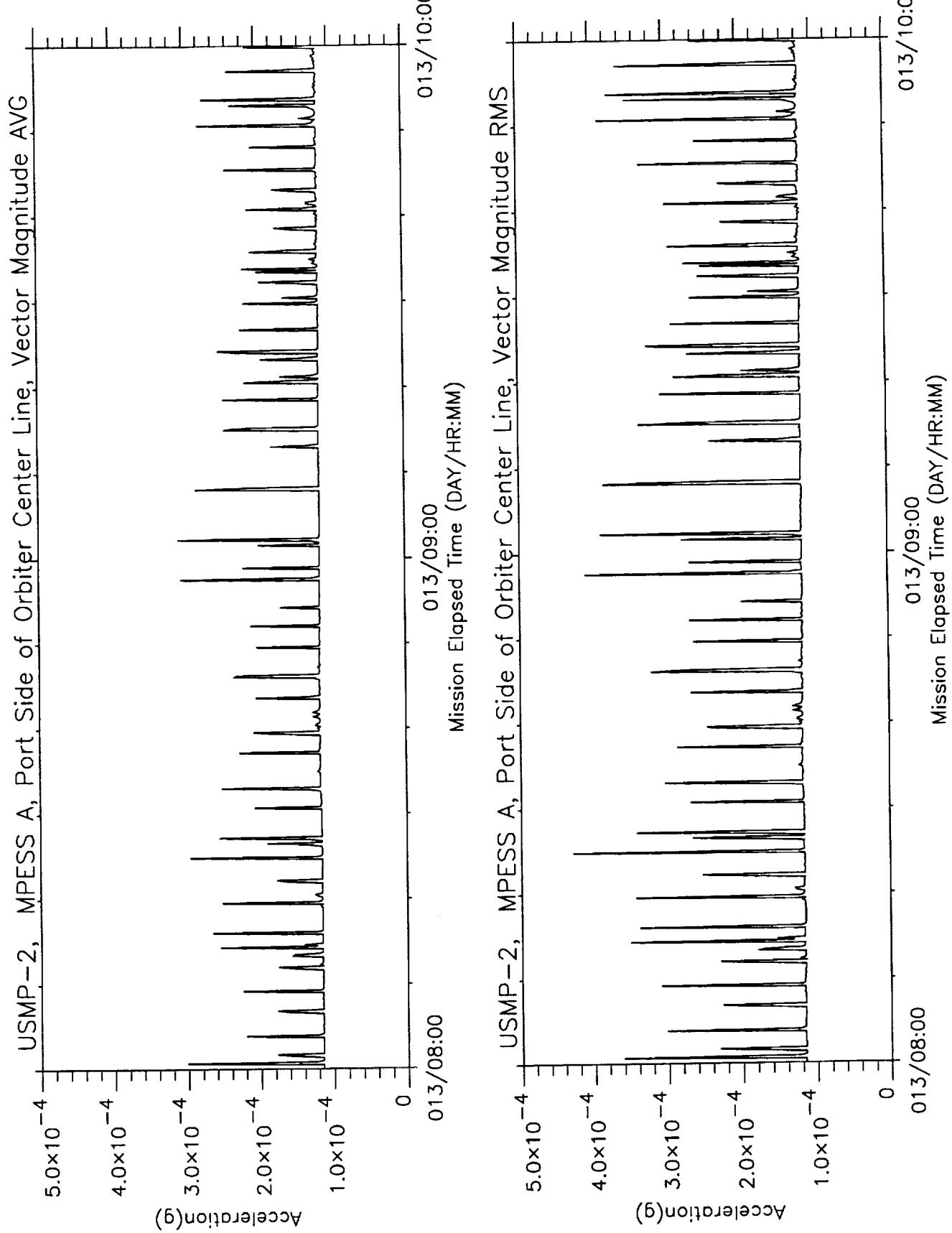
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APPENDIX C SAMS COLOR SPECTROGRAMS

Accelerometer data collected on Orbiter missions are generally analyzed by the PI or experiment team responsible for the system. The PI Microgravity Services (PIMS) project at the NASA Lewis Research Center was formed in part to support microgravity PI's in the evaluation of acceleration effects on their experiments and to characterize the vibrational environment of the Space Shuttle Orbiters. The primary continual source of accelerometer data from mission to mission is SAMS. Some of the SAMS data from STS-62 are presented in Appendices B and C to provide PI's with an overview of the environment during mission.

The raw data recorded by SAMS are processed to compensate for temperature and gain related errors of bias, scale factor, and axis misalignment. The processing utilizes a fourth order temperature model to compensate the data and convert the raw digitized data into engineering units (Thomas, et al., 1992). The data are transformed to the shuttle structural coordinate system and formatted into files for distribution via CD-ROM and file server. See Appendix A for information on file server access to SAMS data.

The SAMS data have been further processed to produce the plots shown here. Color spectrograms are provided as an overview of the frequency characteristics of the SAMS data during the mission. Each spectrogram is a two-hour composite of amplitude spectra for consecutive ten second intervals. These plots should be used to identify times when the frequency character of the acceleration environment changes.

The color spectrograms were produced using STS-62 SAMS Unit F, Head B data. The data were taken in two hour periods and an amplitude spectrum was calculated for consecutive ten second intervals. *The frequency bandwidth for the spectra is 0.1 Hz.

The spectral data were scaled by taking the log of each data point and assigning a color to the integer result. Eight colors were used for eight intervals between 1 ± 10^{-7} g and 1 ± 10^{-3} g. In using this method, a range of acceleration values are assigned to the same color.

References

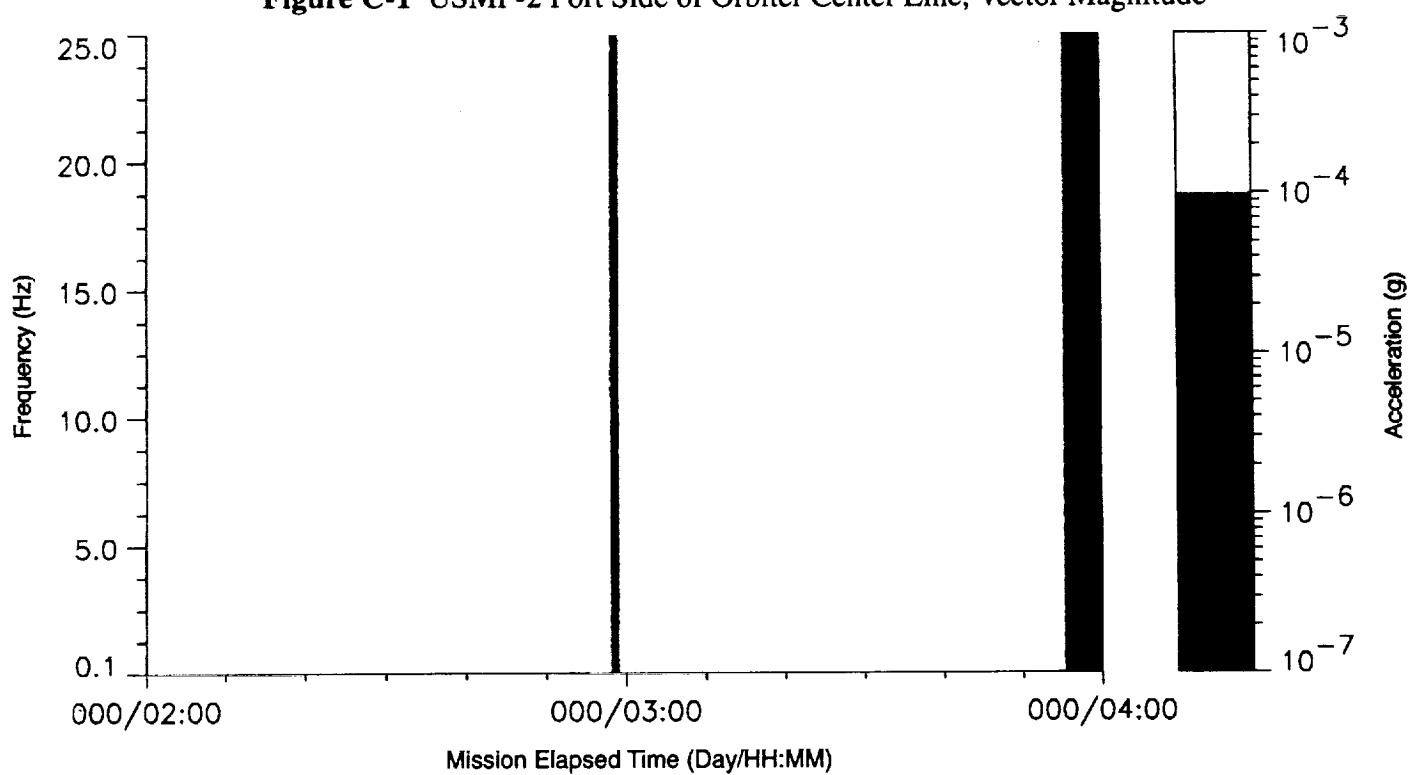
Thomas, J. E., R. B. Peters, B. D. , Finley, Space Acceleration Measurement System triaxial head error budget NASA Technical Memorandum -105300, January 1992.

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SUMMARY REPORT OF MISSION ACCELERATION MEASUREMENTS FOR STS-62

Figure C-1 USMP-2 Port Side of Orbiter Center Line, Vector Magnitude



NO DATA AVAILABLE FOR USMP-2, UNIT F, HEAD B

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SUMMARY REPORT OF MISSION ACCELERATION MEASUREMENTS FOR STS-62

Figure C-2 USMP-2 Port Side of Orbiter Center Line, Vector Magnitude

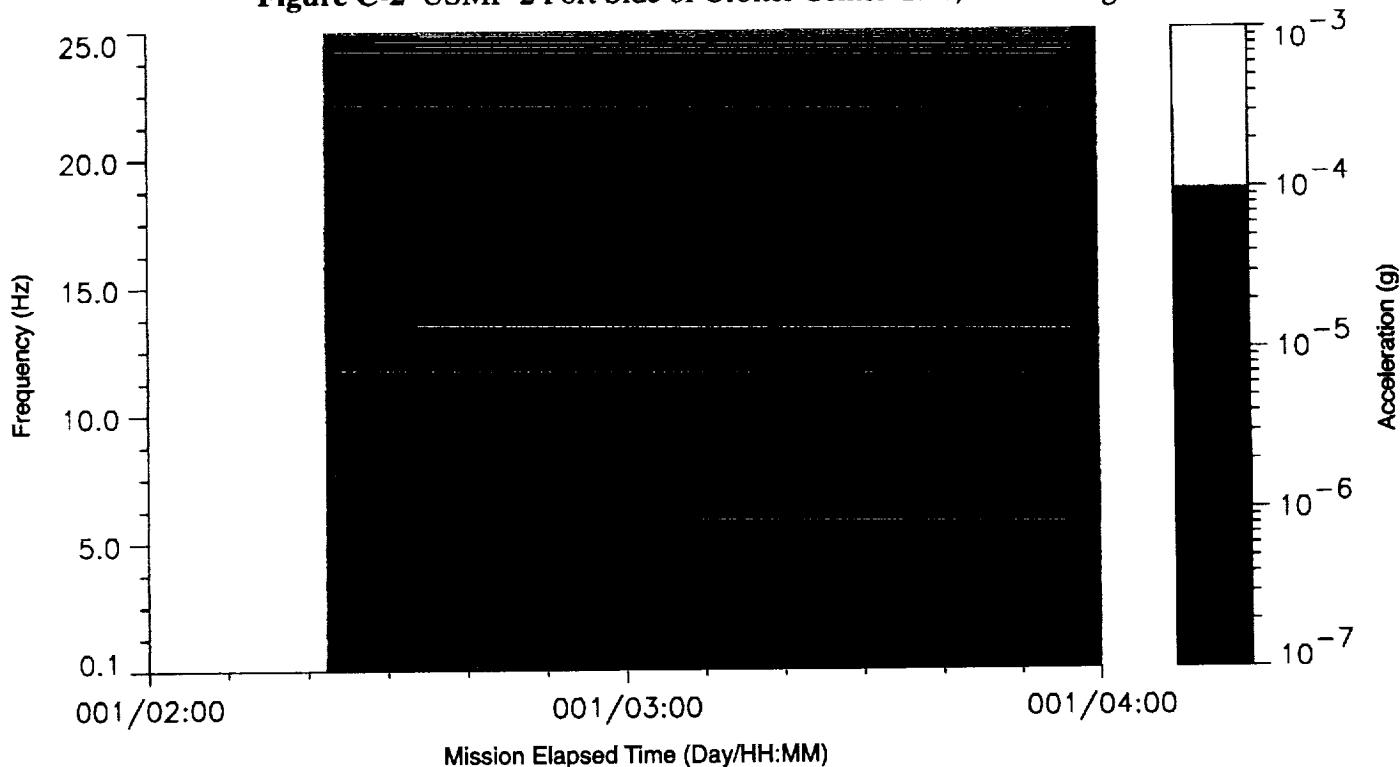
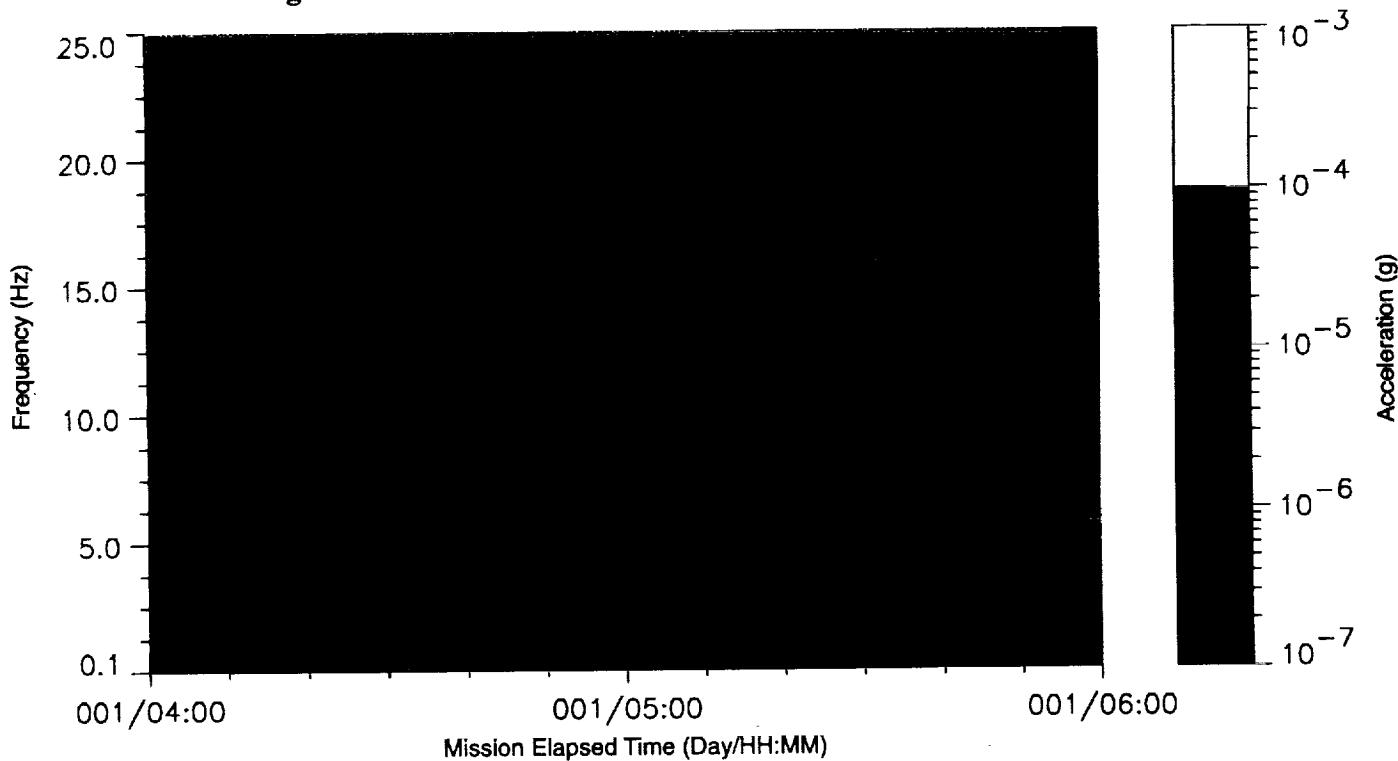


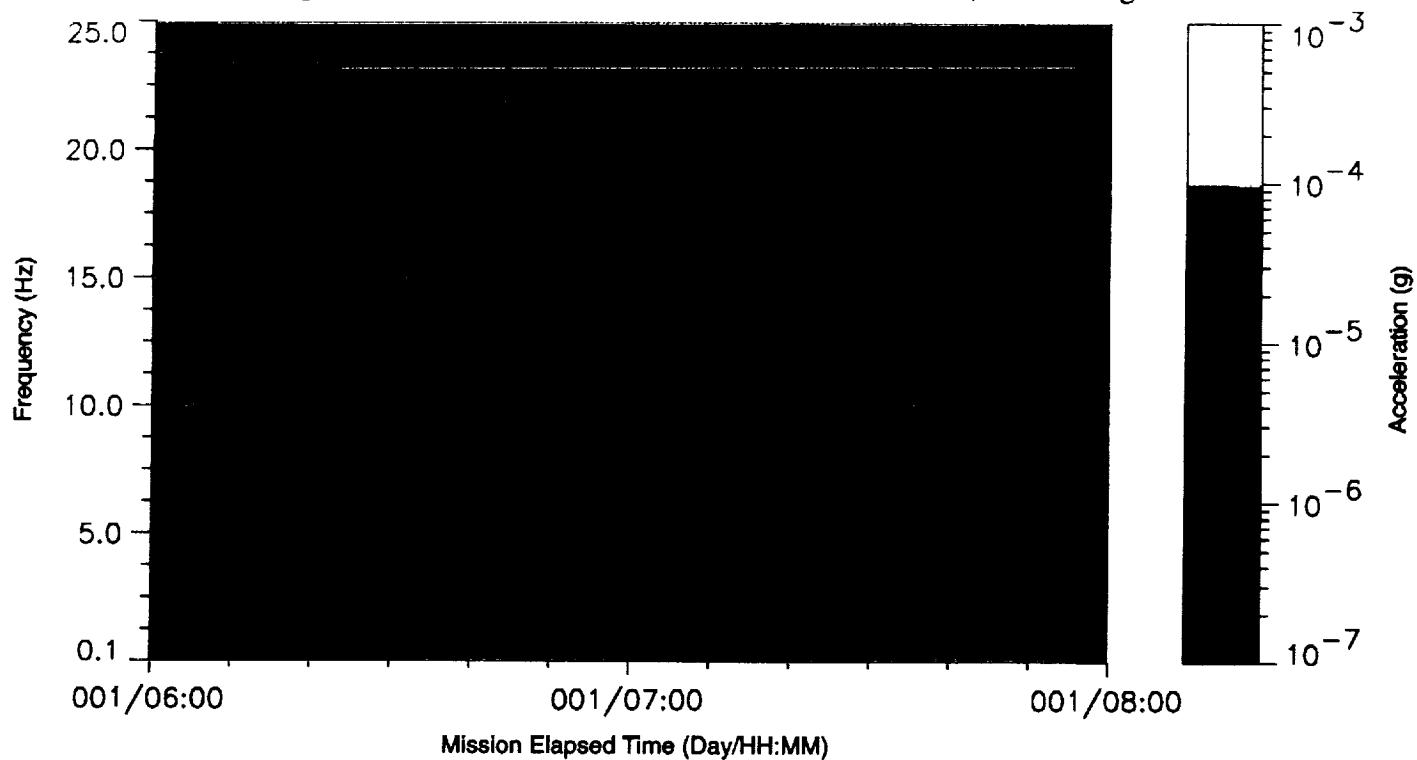
Figure C-3 USMP-2 Port Side of Orbiter Center Line, Vector Magnitude





SUMMARY REPORT OF MISSION ACCELERATION MEASUREMENTS FOR STS-62

Figure C-4 USMP-2 Port Side of Orbiter Center Line, Vector Magnitude



NO DATA AVAILABLE FOR USMP-2, UNIT F, HEAD B

FROM MET 001/08:00:00 - 002/02:12:00



SUMMARY REPORT OF MISSION ACCELERATION MEASUREMENTS FOR STS-62

Figure C-5 USMP-2 Port Side of Orbiter Center Line, Vector Magnitude

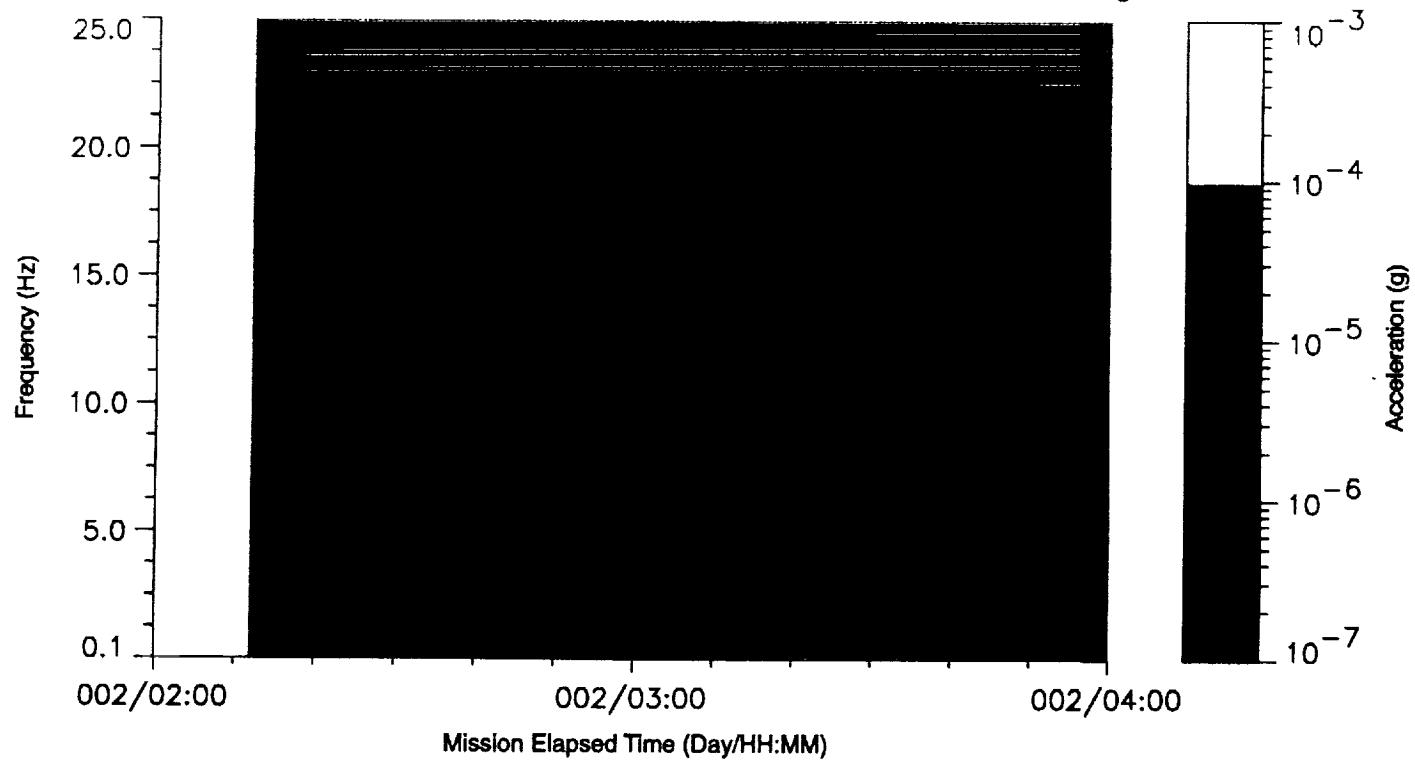
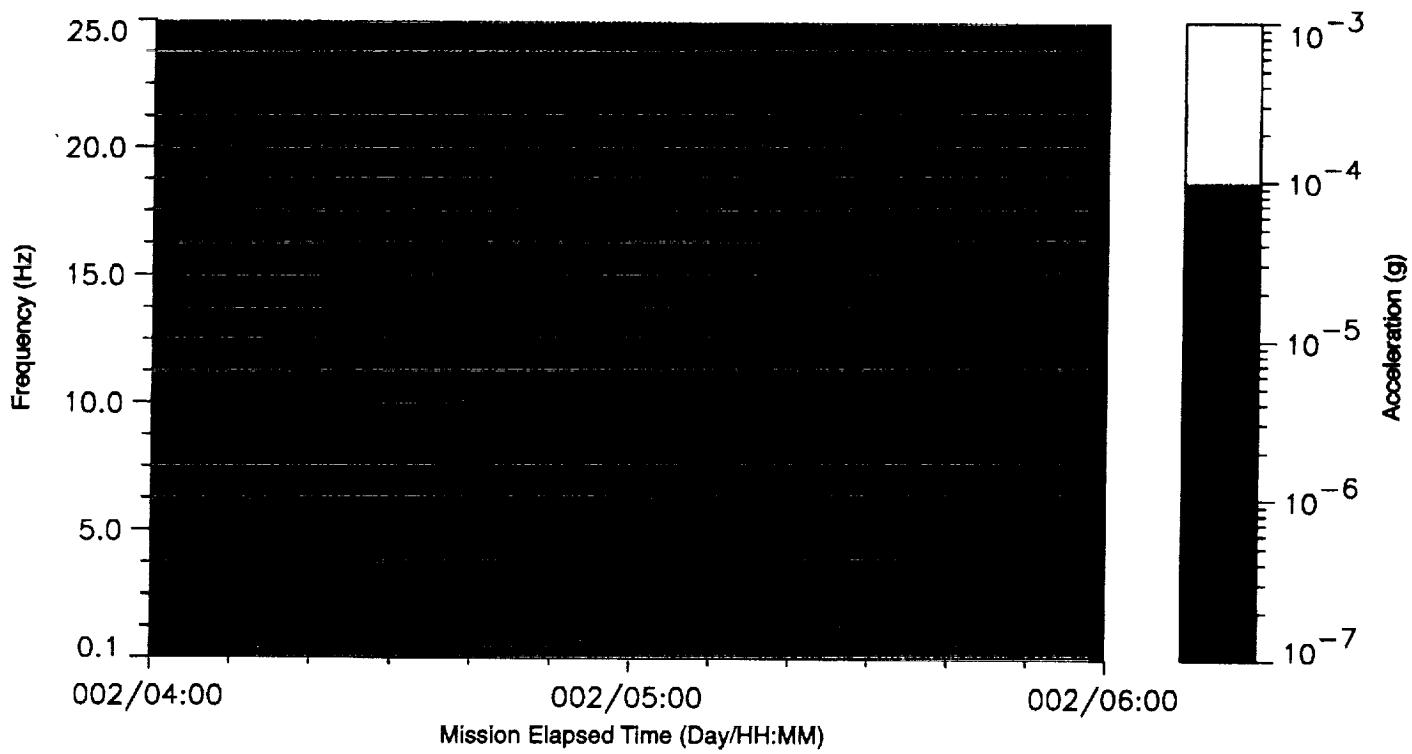
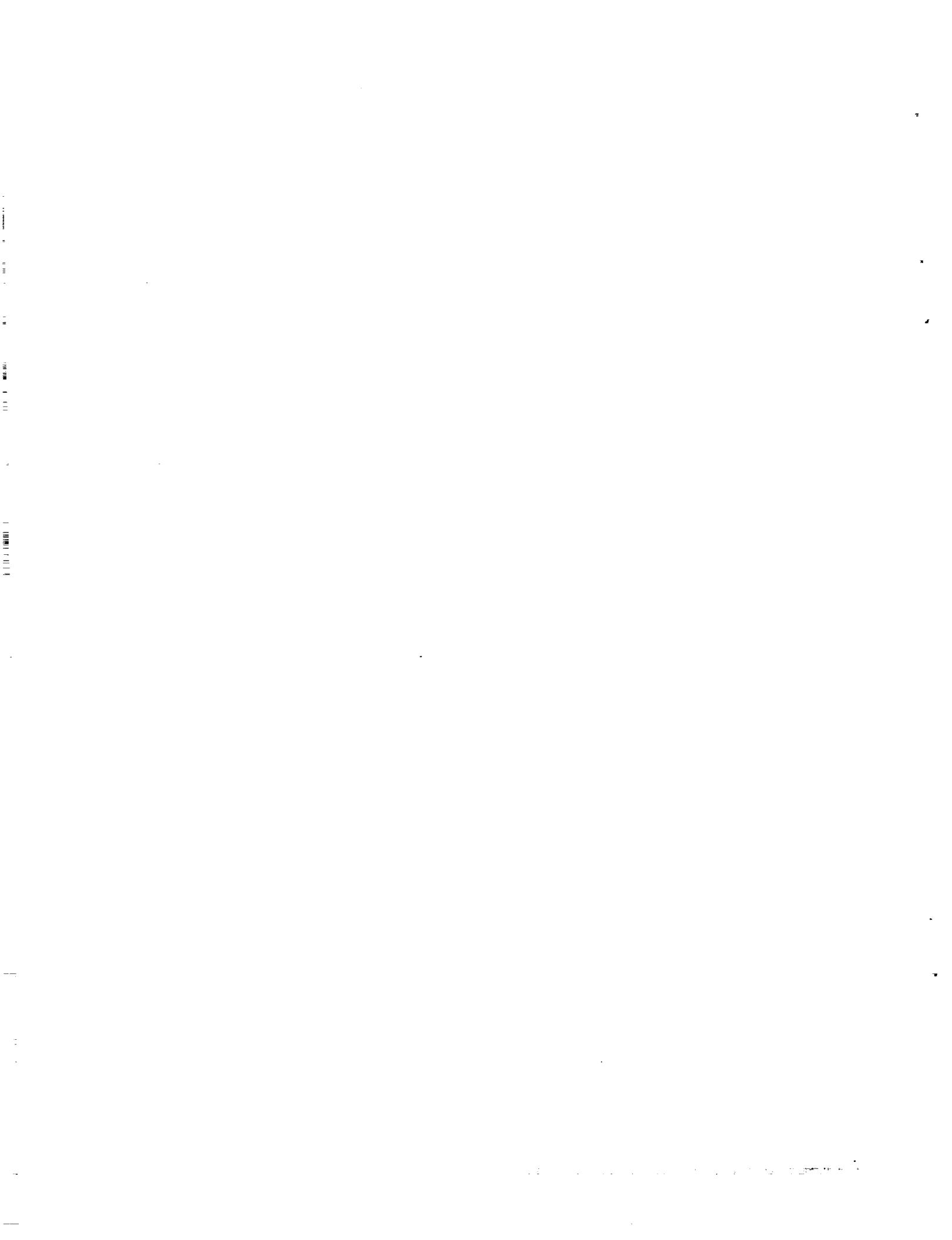


Figure C-6 USMP-2 Port Side of Orbiter Center Line, Vector Magnitude





SUMMARY REPORT OF MISSION ACCELERATION MEASUREMENTS FOR STS-62

Figure C-7 USMP-2 Port Side of Orbiter Center Line, Vector Magnitude

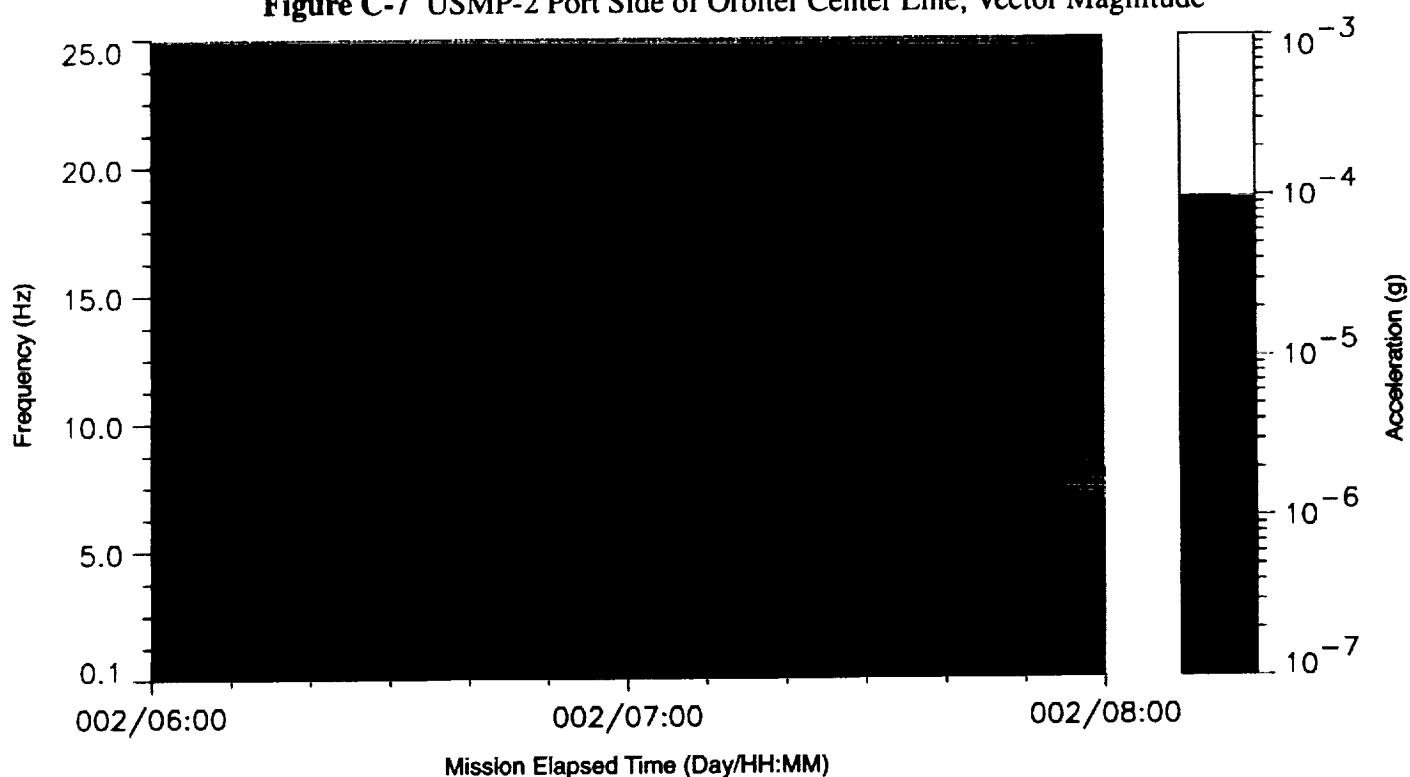
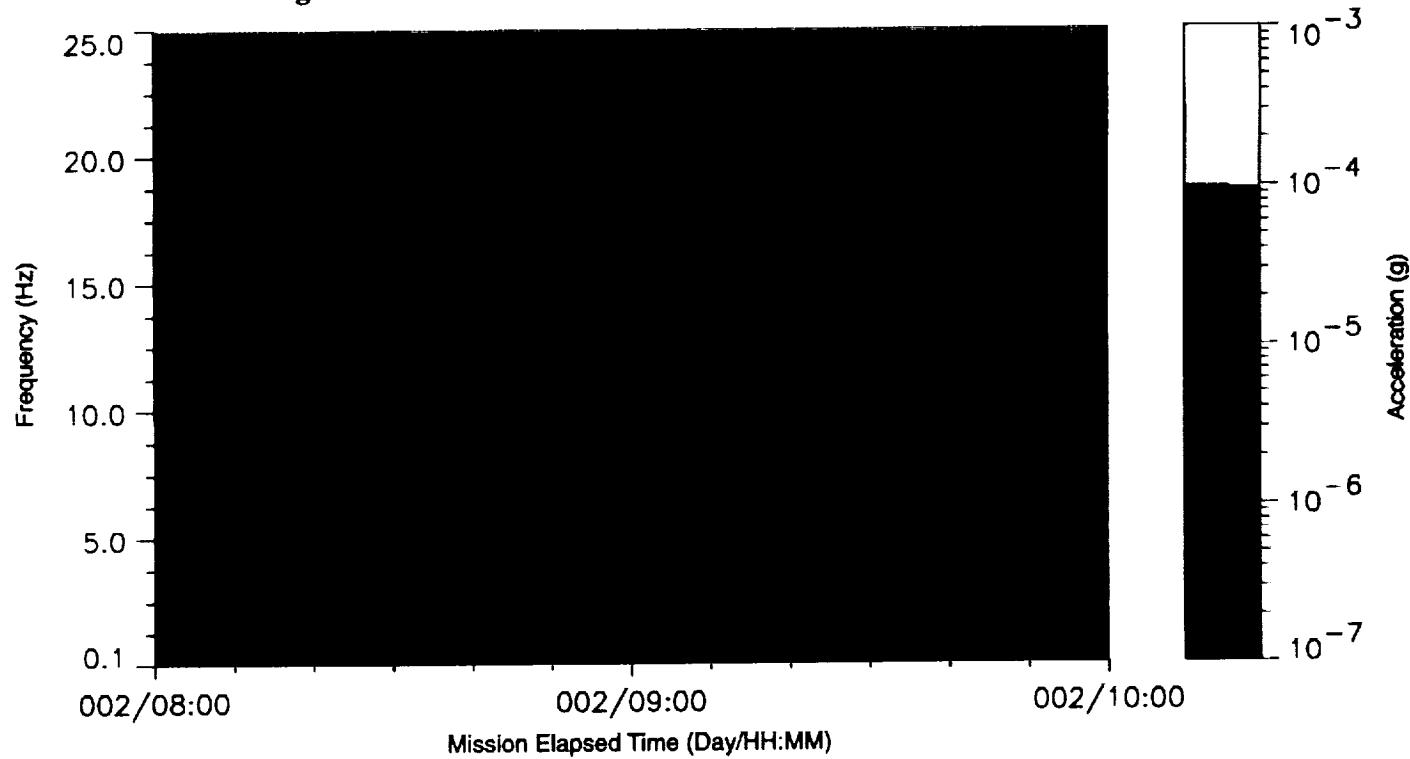


Figure C-8 USMP-2 Port Side of Orbiter Center Line, Vector Magnitude



SUMMARY REPORT OF MISSION ACCELERATION MEASUREMENTS FOR STS-62

Figure C-9 USMP-2 Port Side of Orbiter Center Line, Vector Magnitude

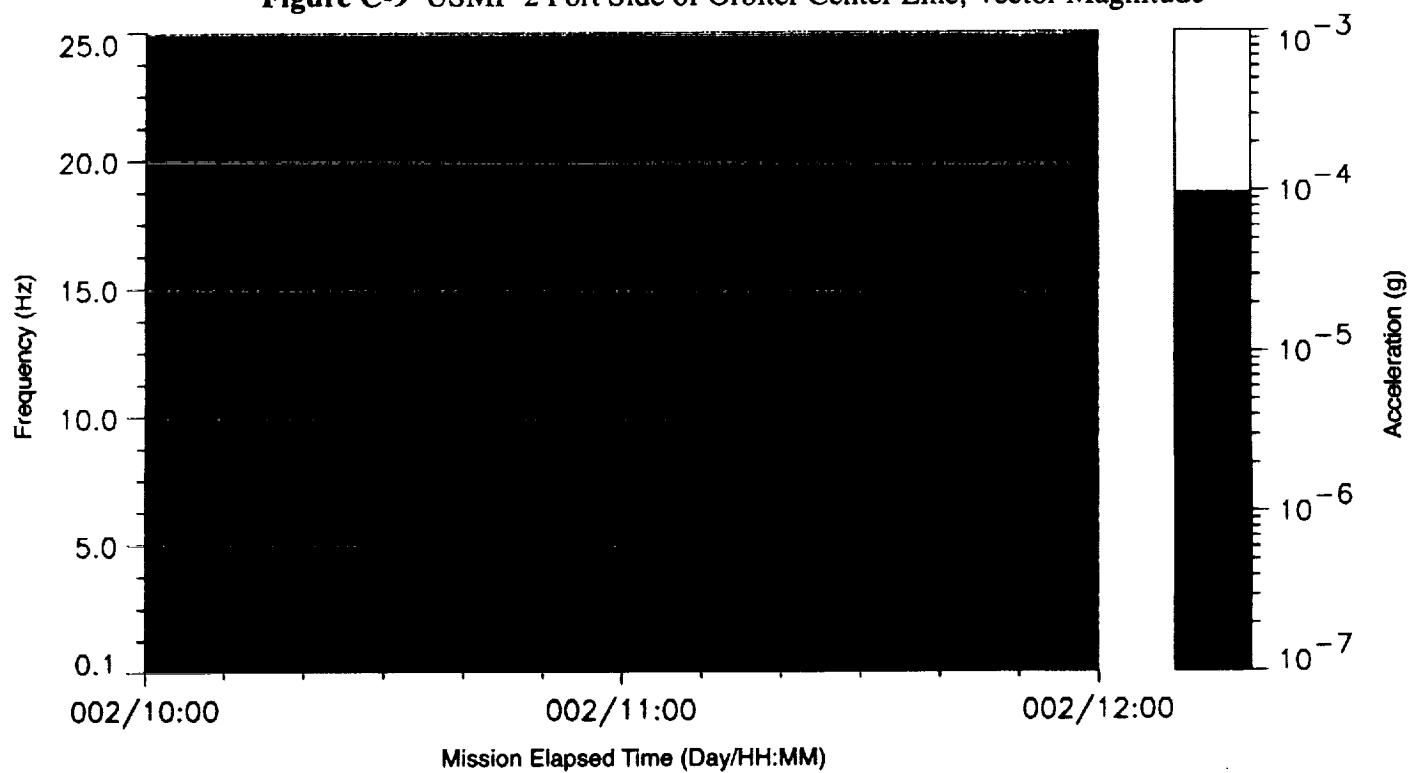
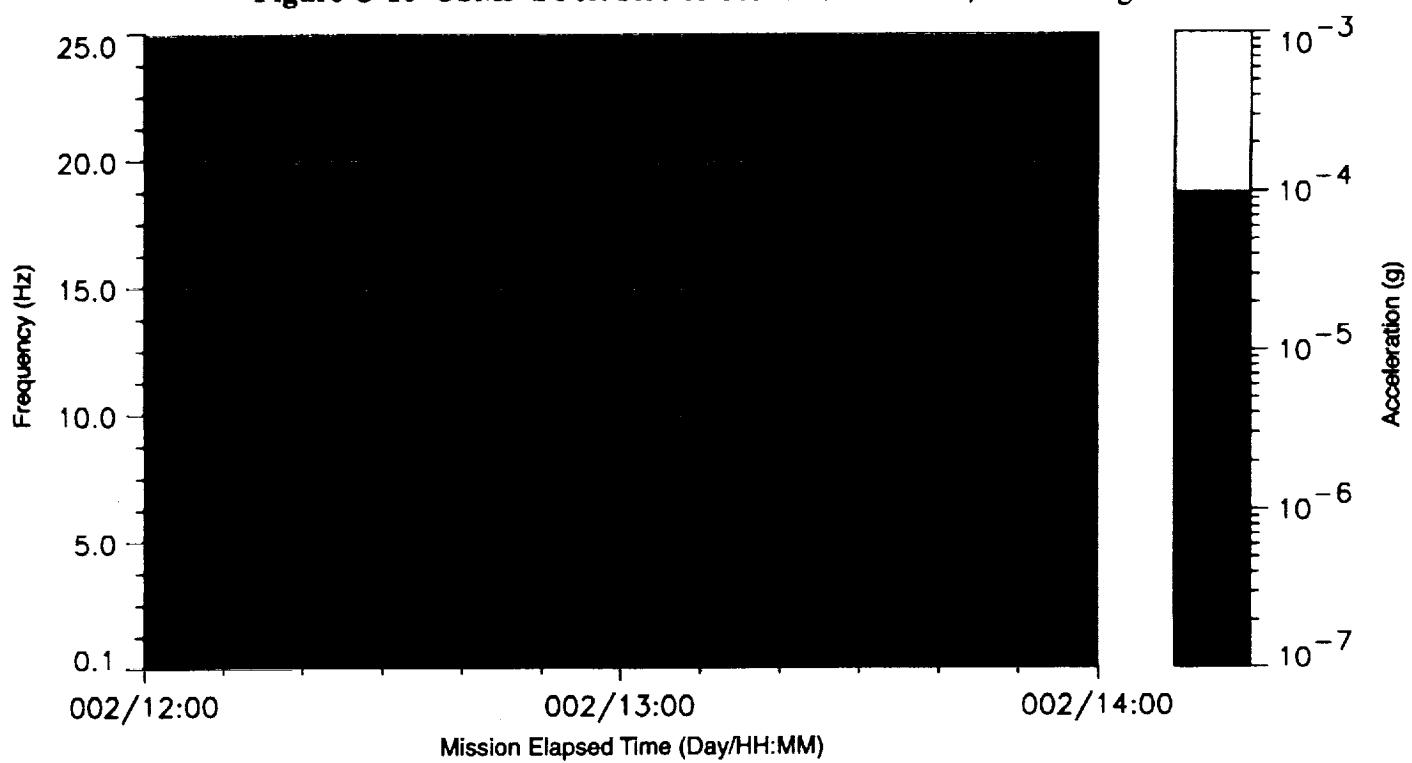


Figure C-10 USMP-2 Port Side of Orbiter Center Line, Vector Magnitude



SUMMARY REPORT OF MISSION ACCELERATION MEASUREMENTS FOR STS-62

Figure C-11 USMP-2 Port Side of Orbiter Center Line, Vector Magnitude

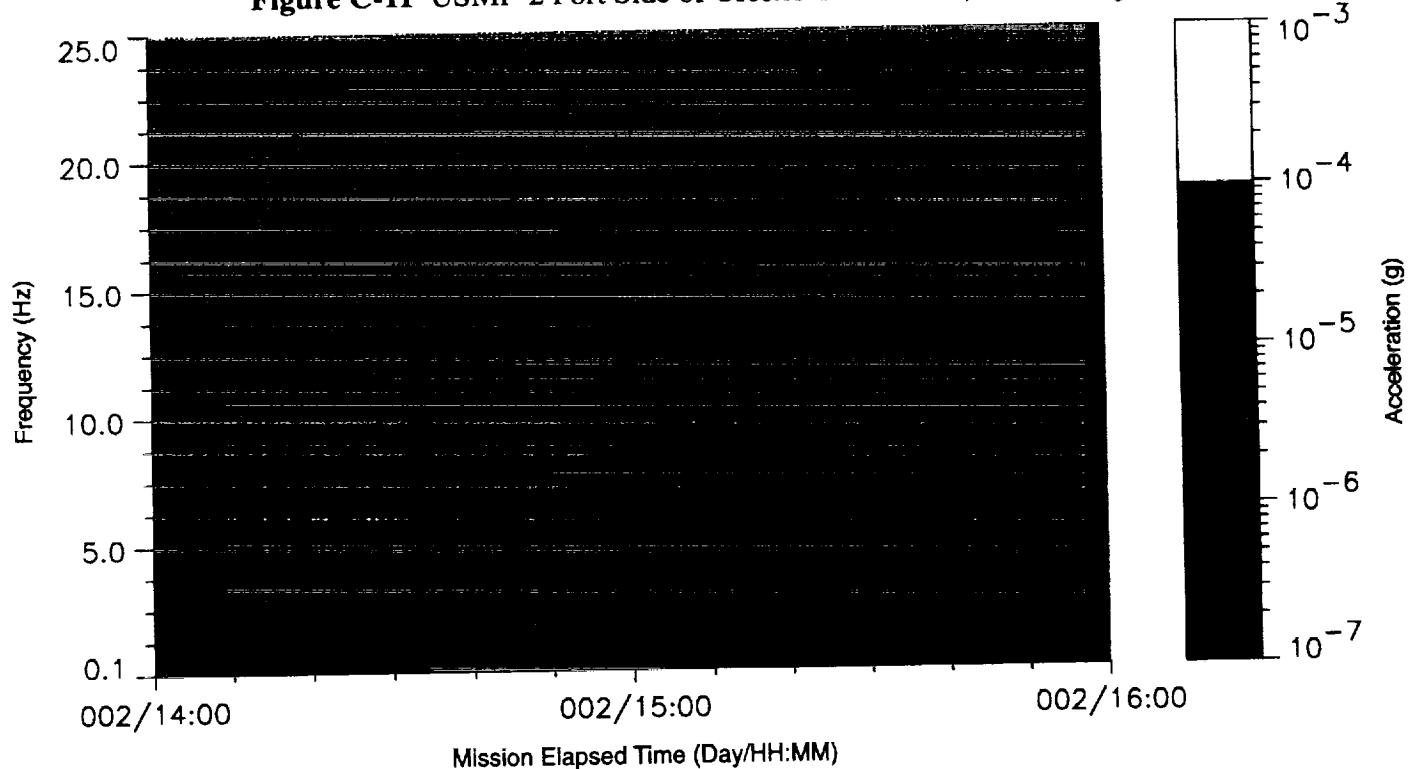
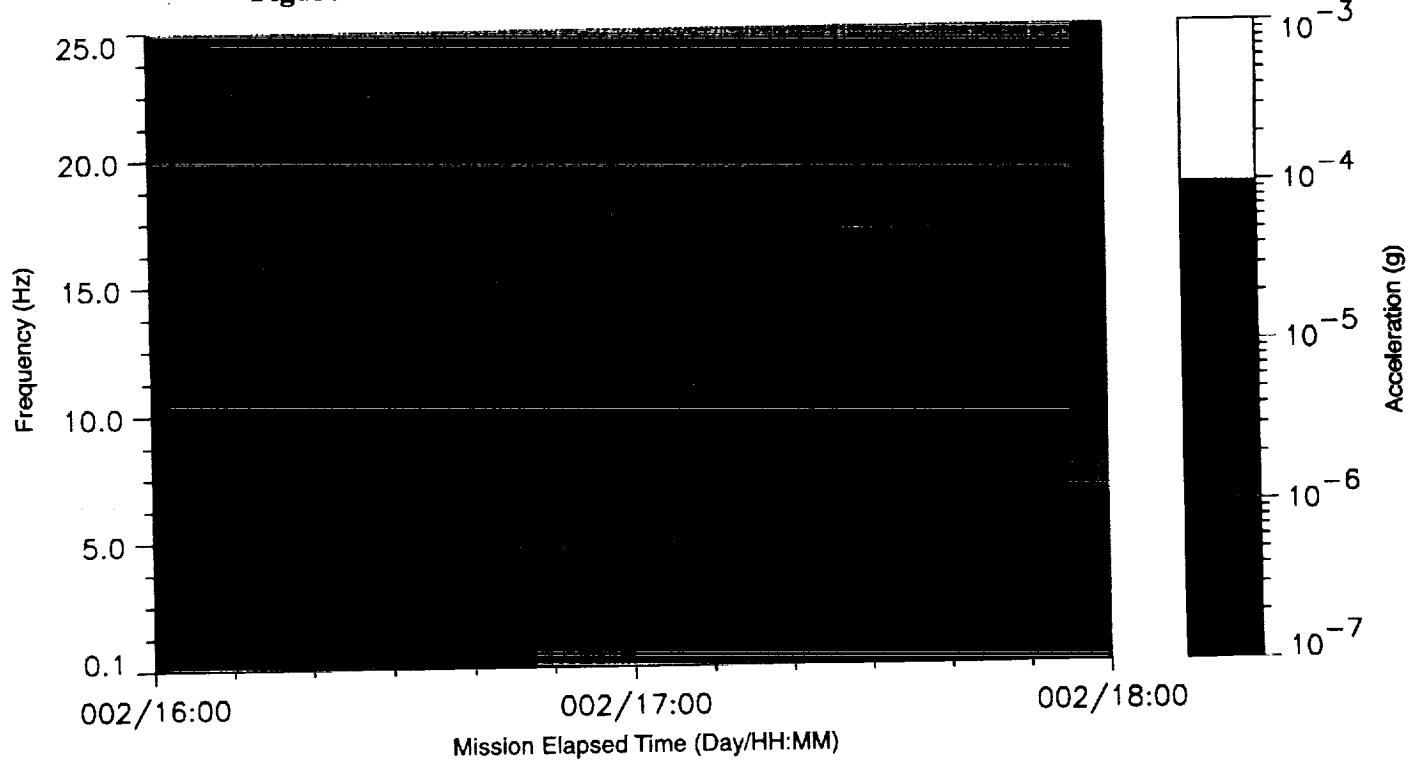
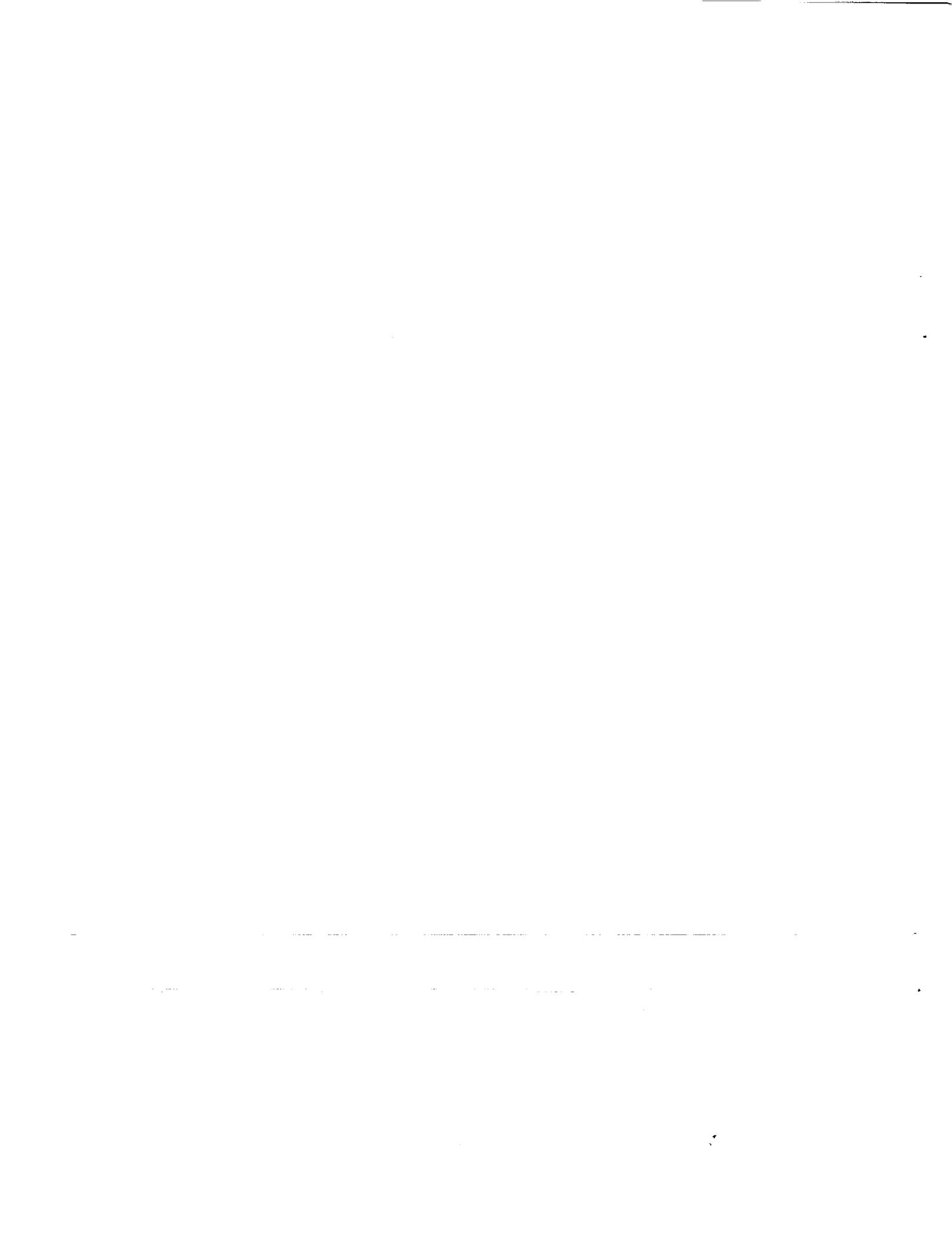


Figure C-12 USMP-2 Port Side of Orbiter Center Line, Vector Magnitude





SUMMARY REPORT OF MISSION ACCELERATION MEASUREMENTS FOR STS-62

Figure C-13 USMP-2 Port Side of Orbiter Center Line, Vector Magnitude

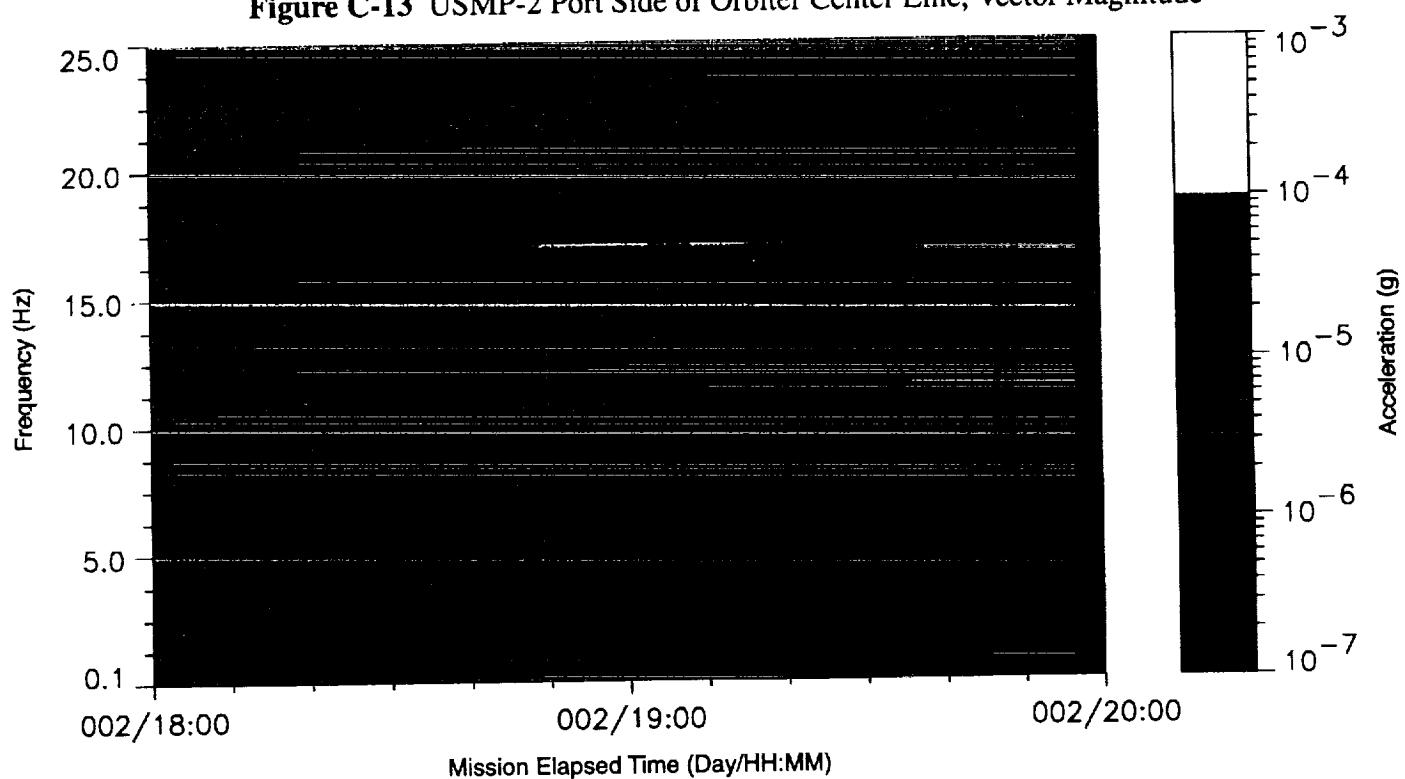
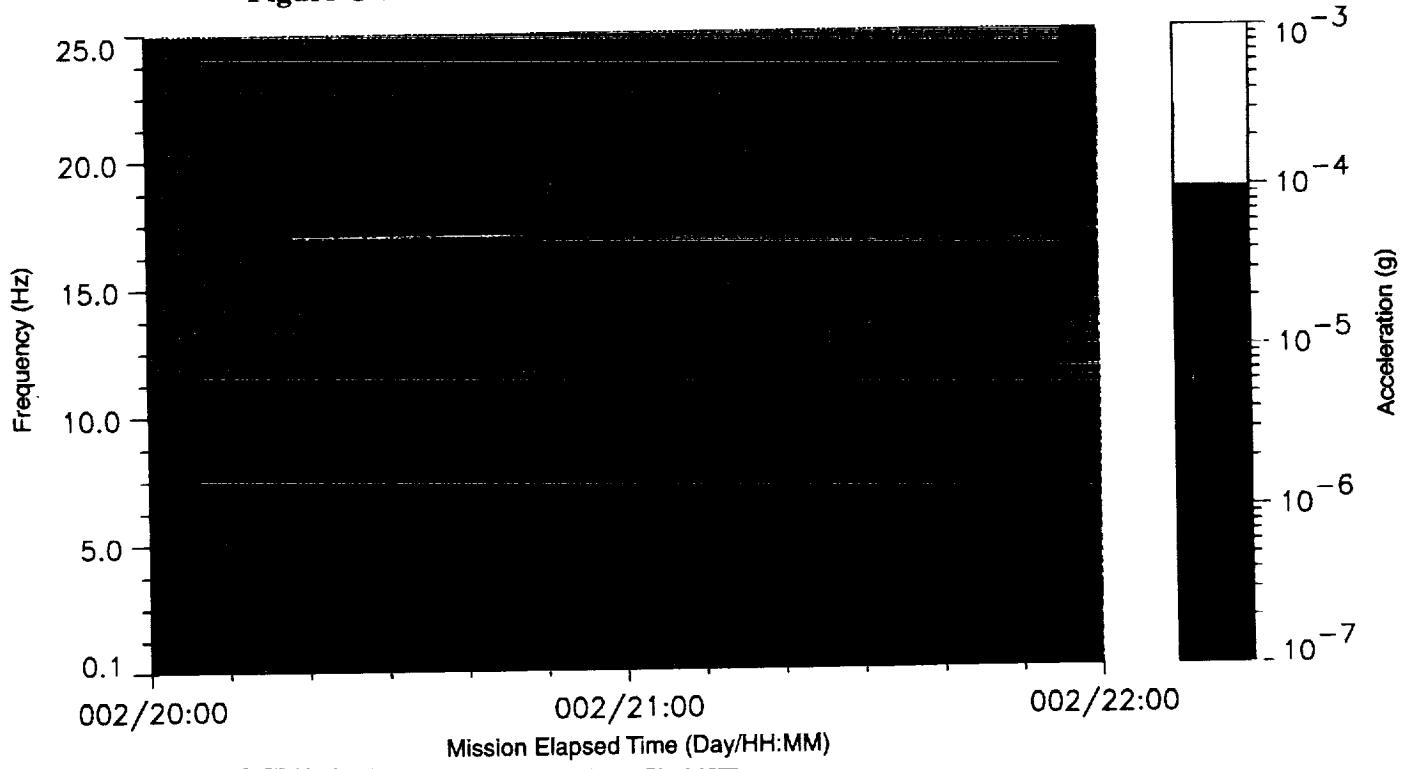
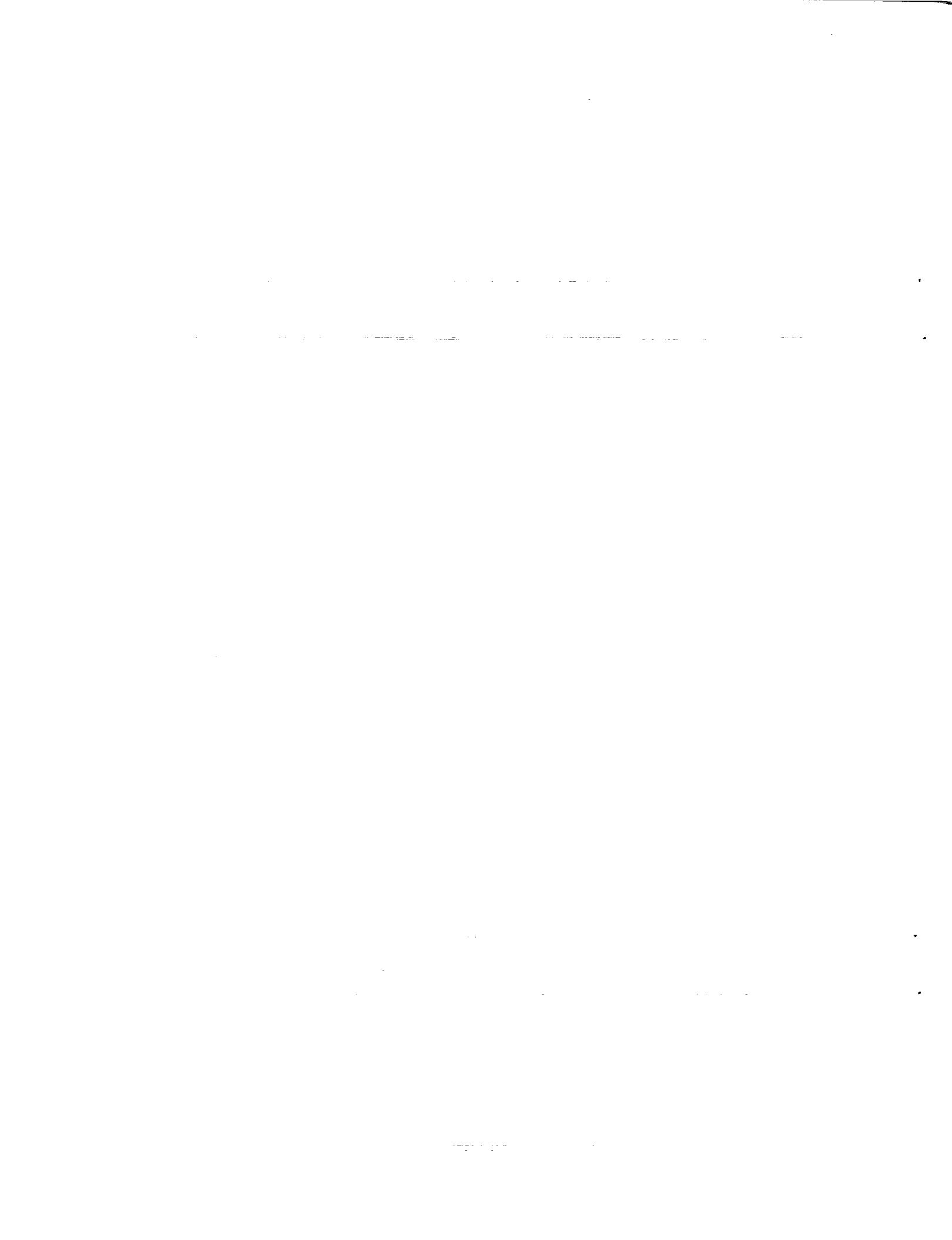


Figure C-14 USMP-2 Port Side of Orbiter Center Line, Vector Magnitude



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SUMMARY REPORT OF MISSION ACCELERATION MEASUREMENTS FOR STS-62

Figure C-15 USMP-2 Port Side of Orbiter Center Line, Vector Magnitude

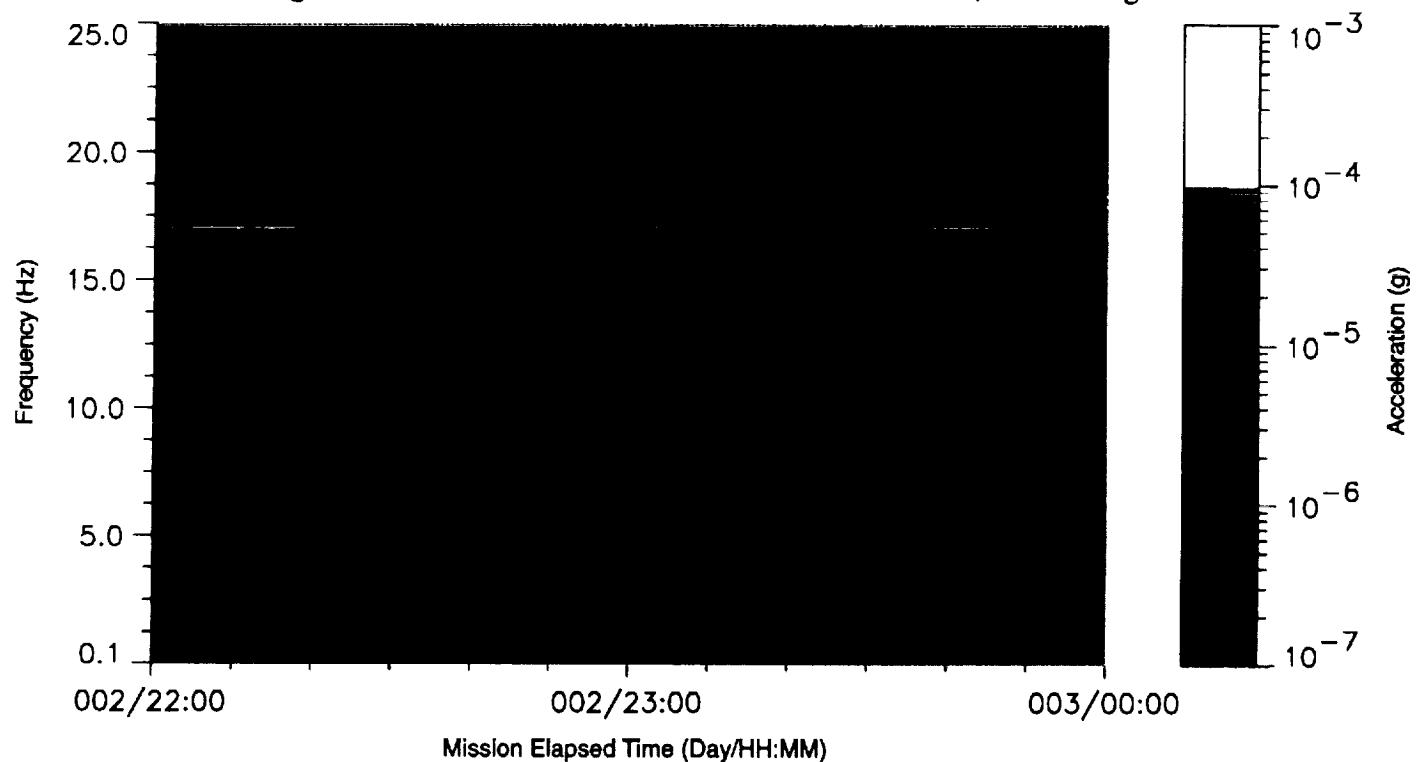
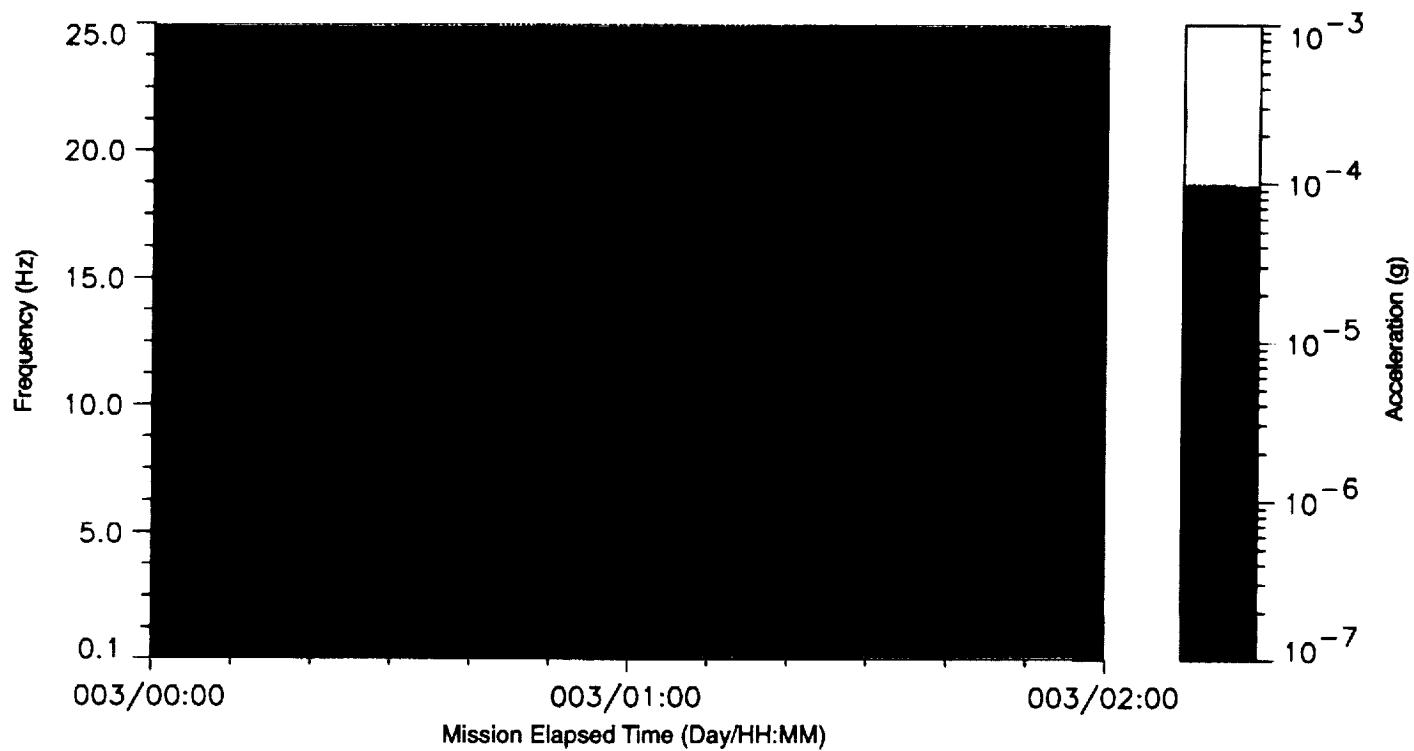
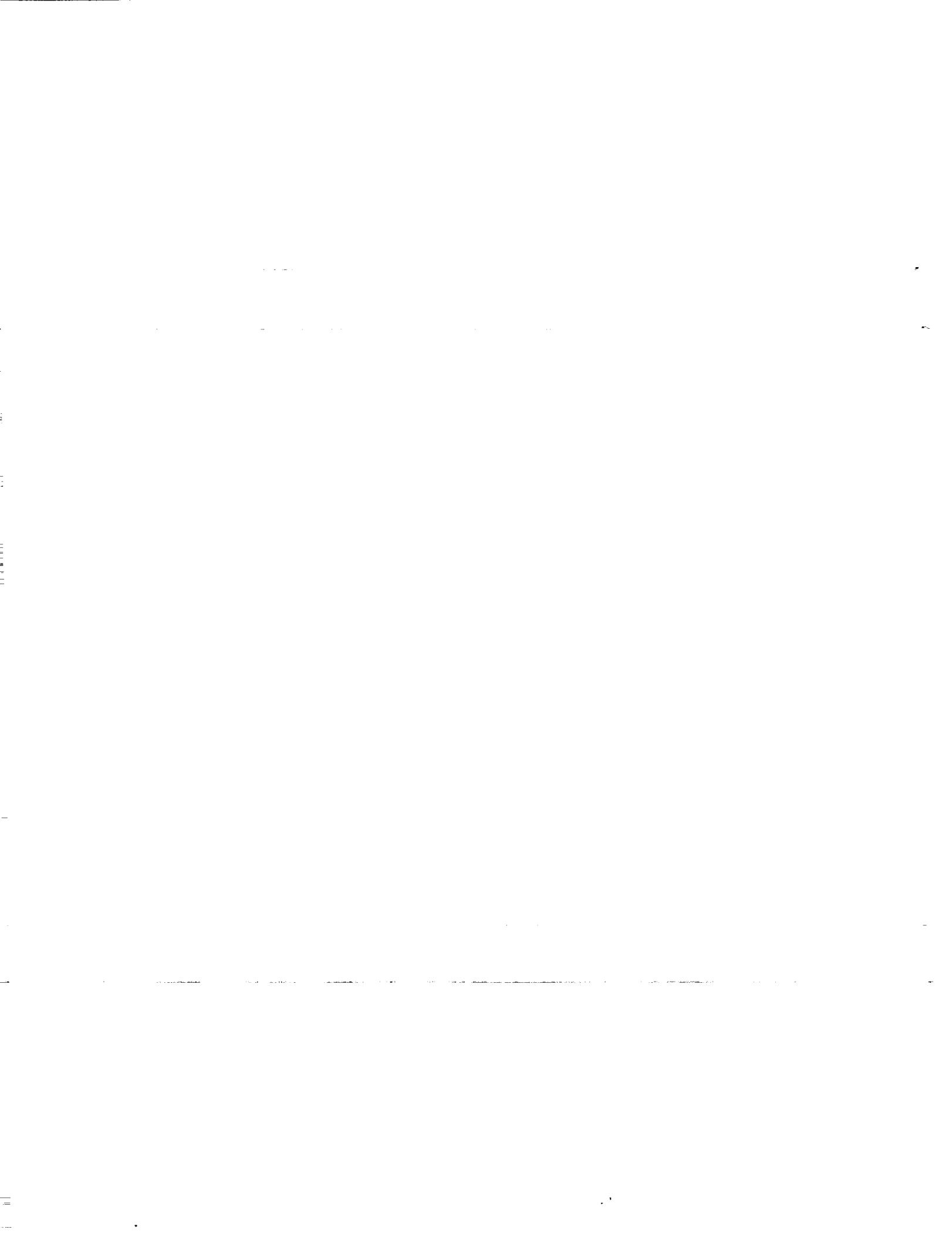


Figure C-16 USMP-2 Port Side of Orbiter Center Line, Vector Magnitude





SUMMARY REPORT OF MISSION ACCELERATION MEASUREMENTS FOR STS-62

Figure C-17 USMP-2 Port Side of Orbiter Center Line, Vector Magnitude

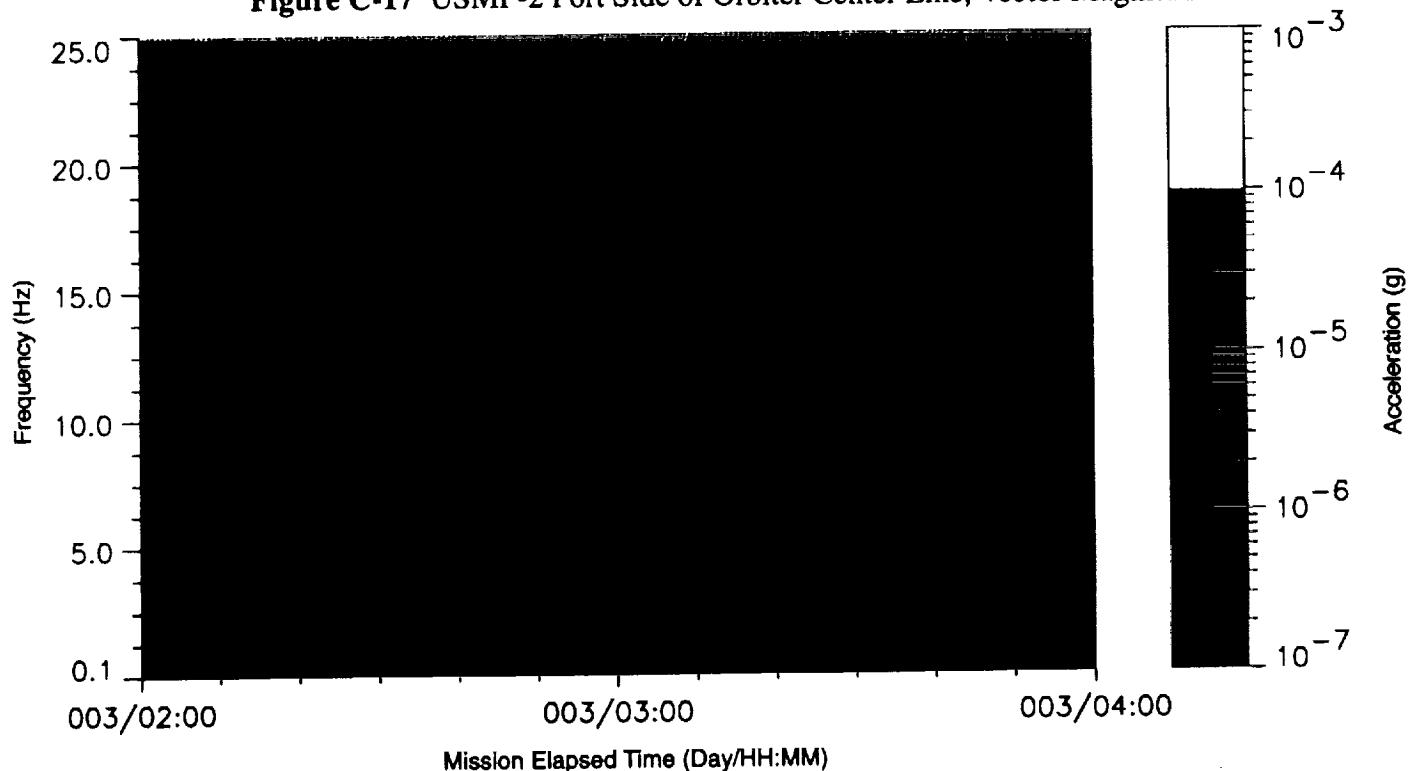
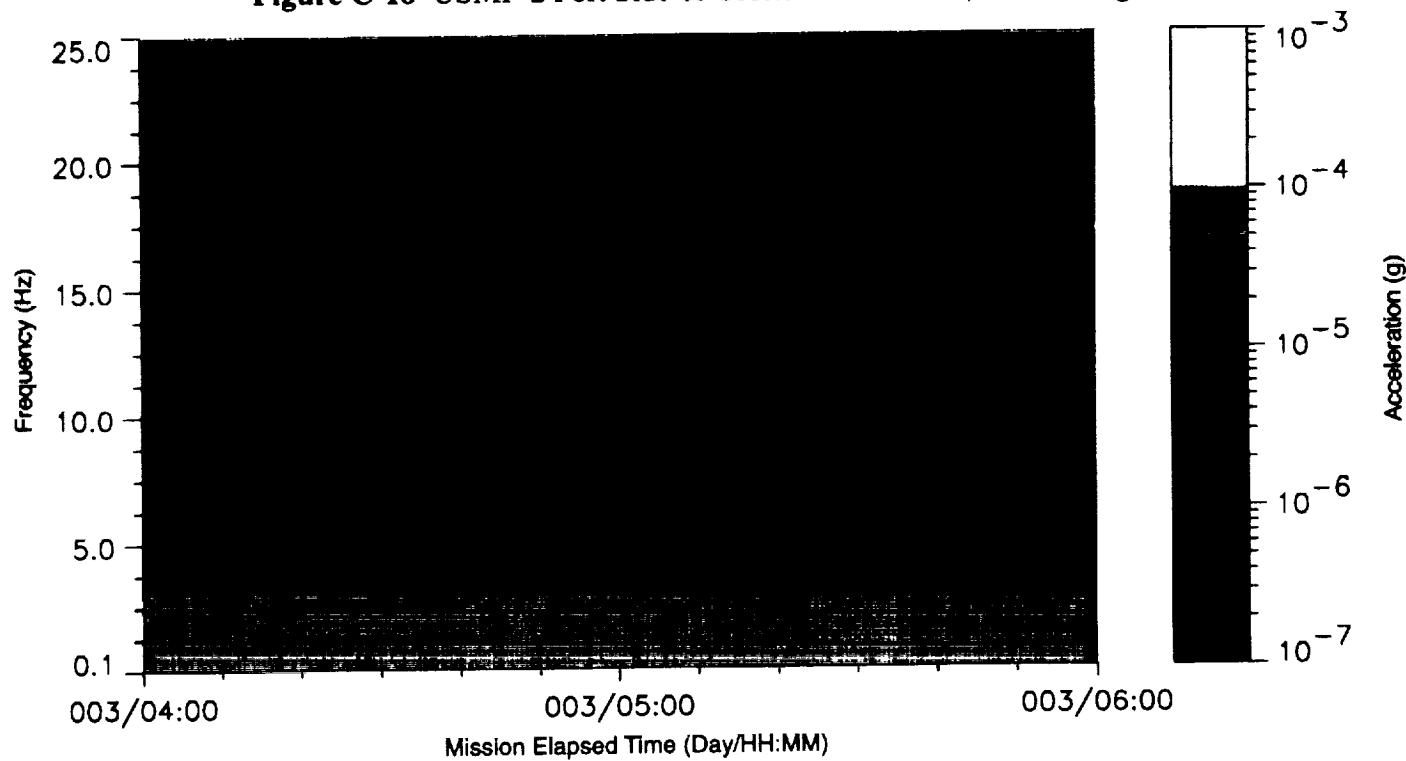
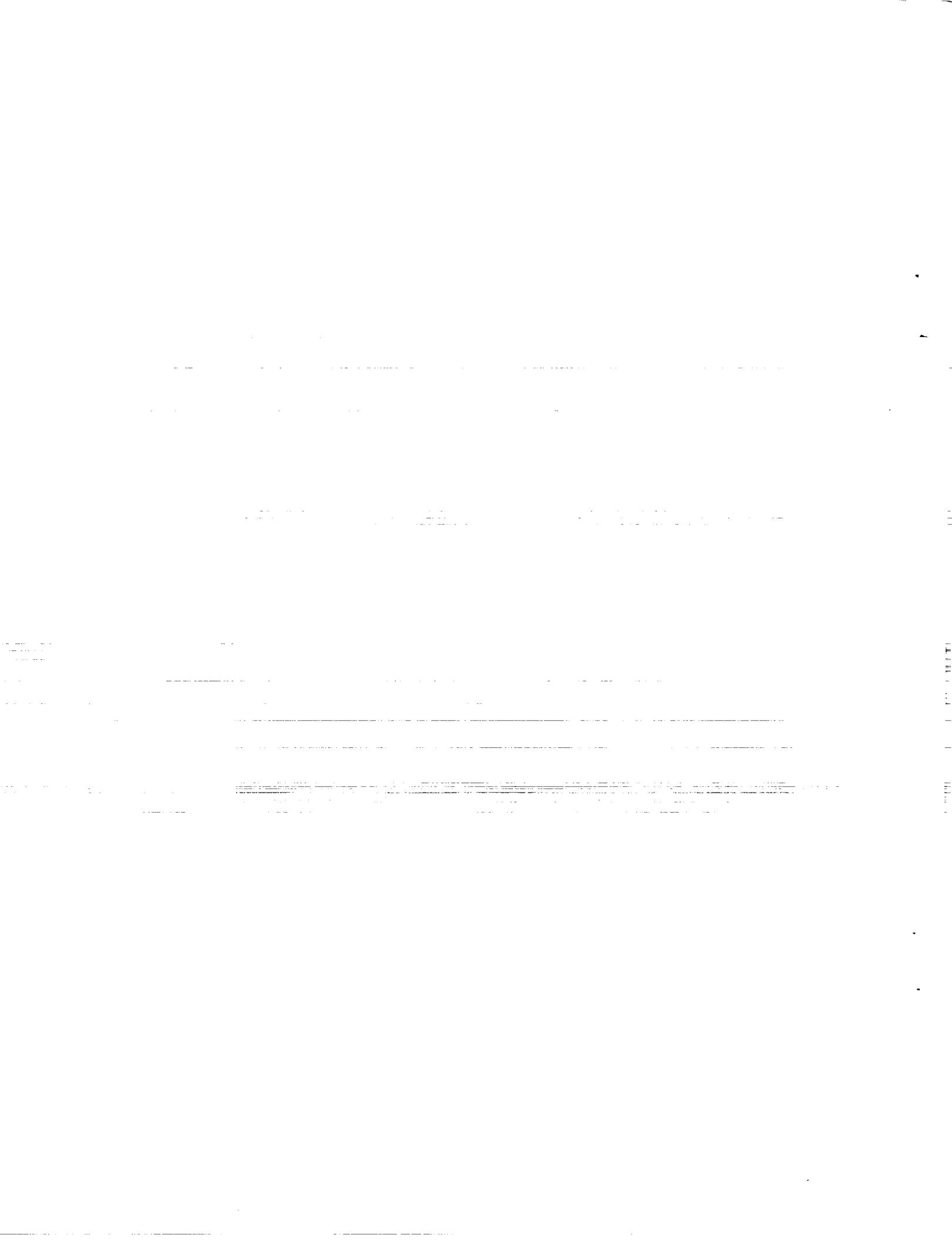


Figure C-18 USMP-2 Port Side of Orbiter Center Line, Vector Magnitude





SUMMARY REPORT OF MISSION ACCELERATION MEASUREMENTS FOR STS-62

Figure C-19 USMP-2 Port Side of Orbiter Center Line, Vector Magnitude

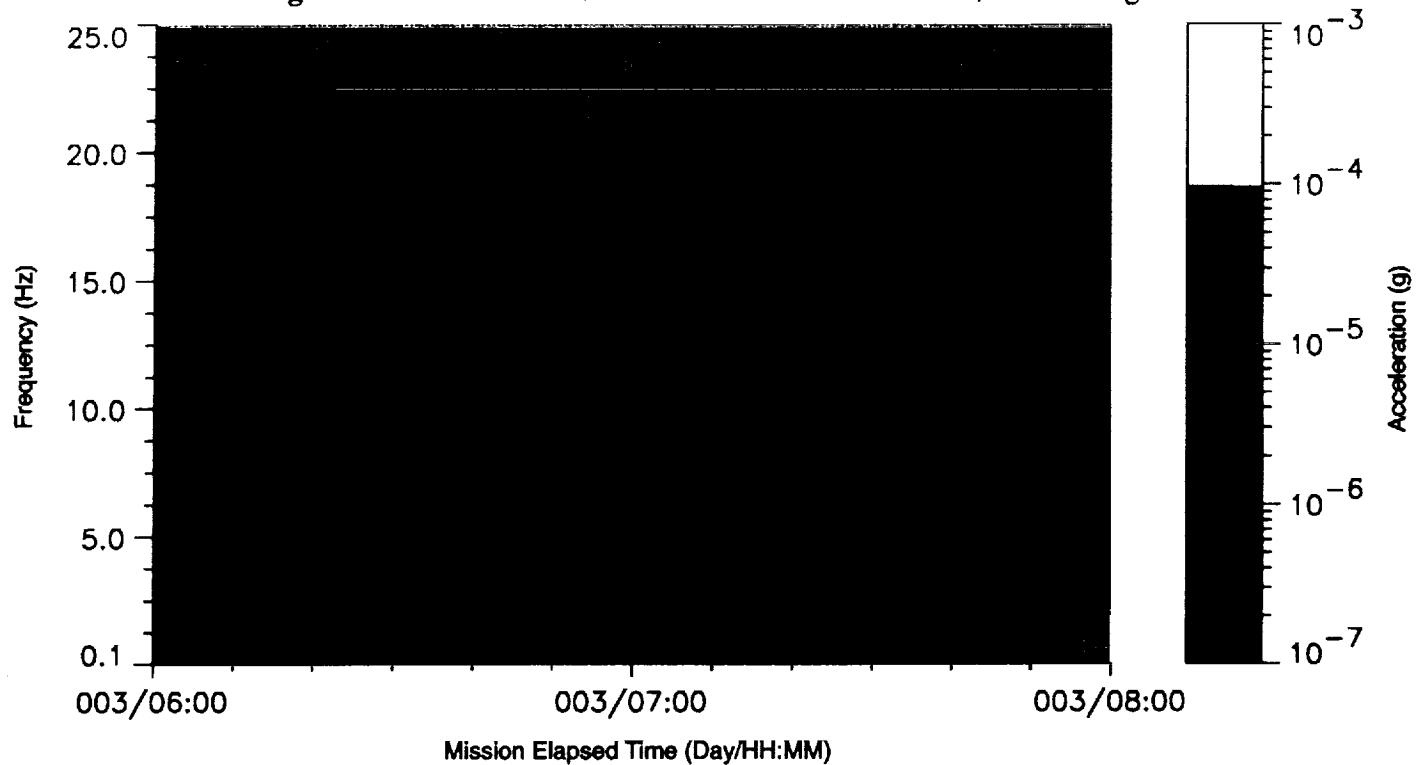
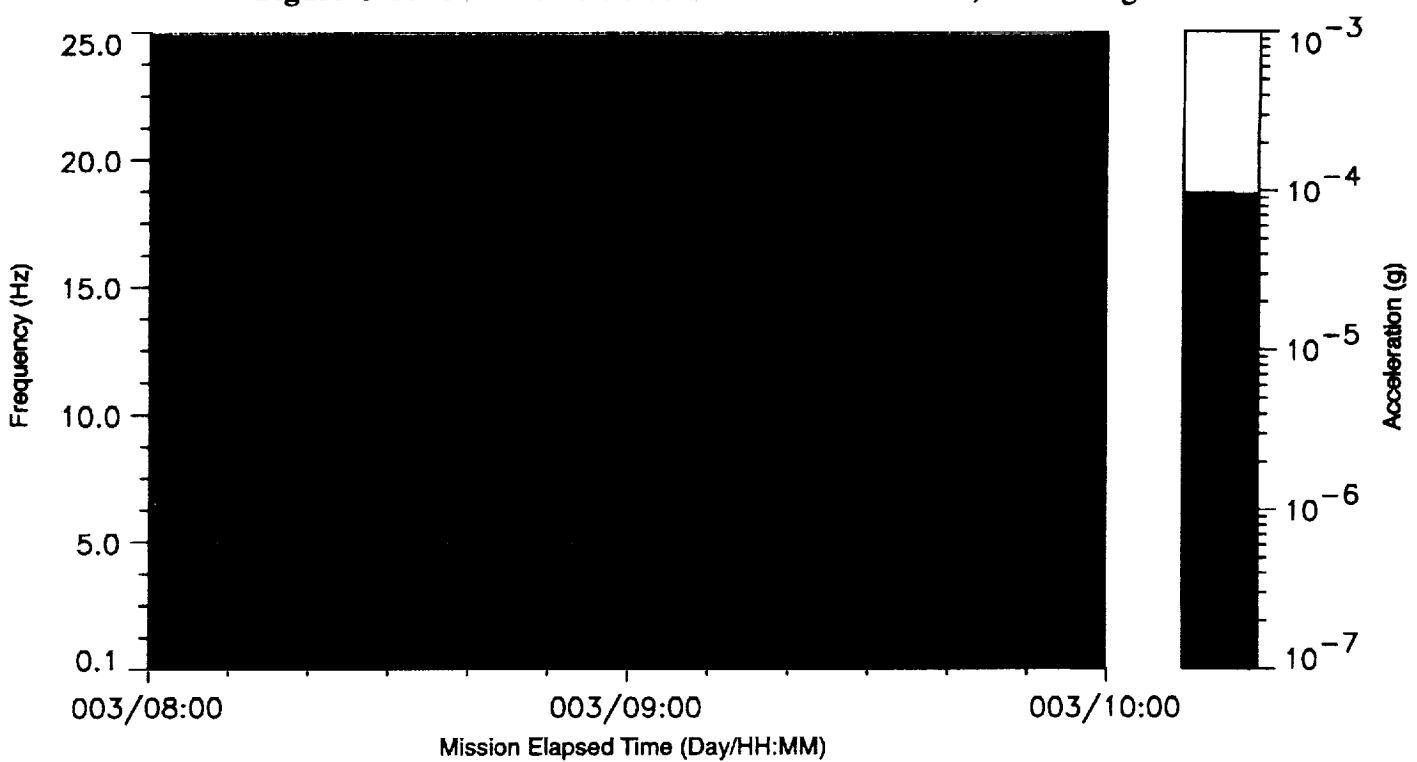


Figure C-20 USMP-2 Port Side of Orbiter Center Line, Vector Magnitude





SUMMARY REPORT OF MISSION ACCELERATION MEASUREMENTS FOR STS-62

Figure C-21 USMP-2 Port Side of Orbiter Center Line, Vector Magnitude

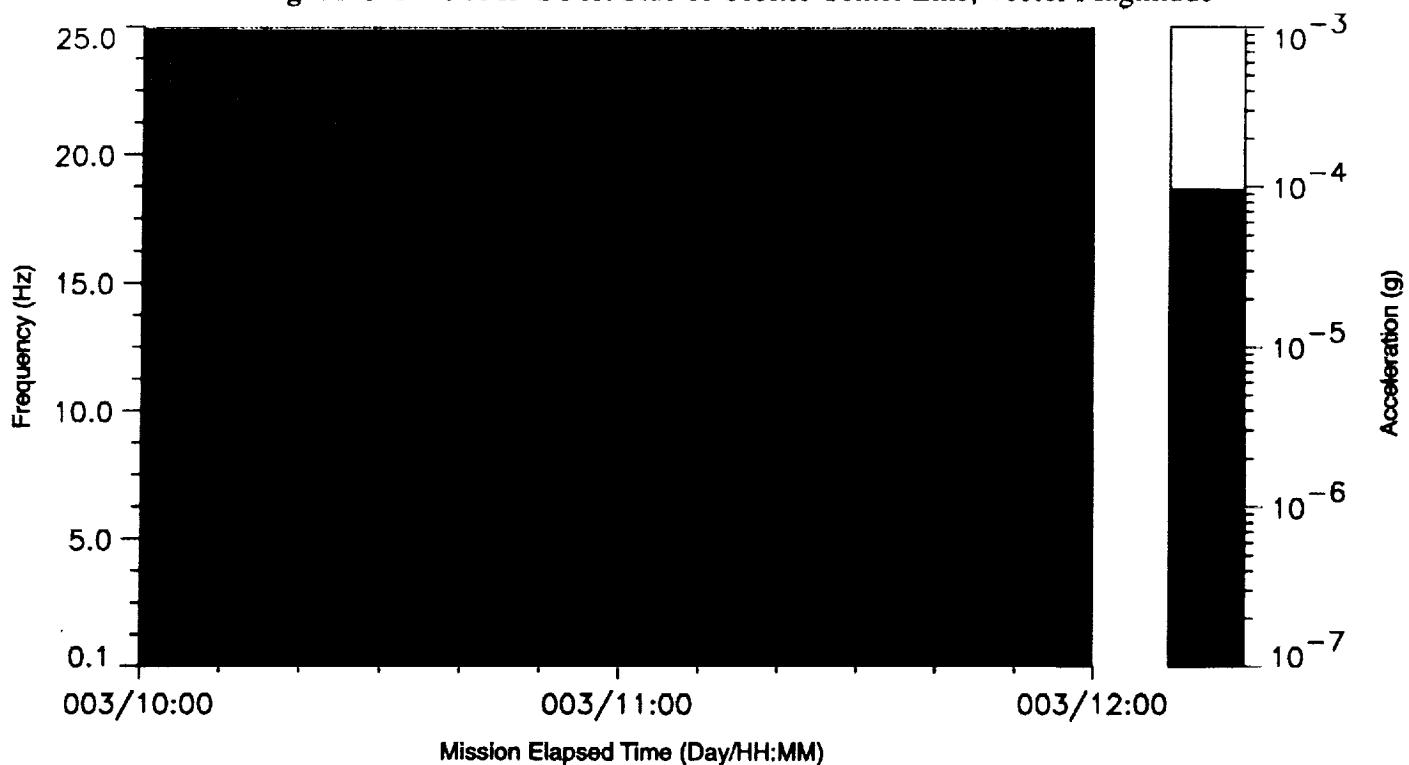
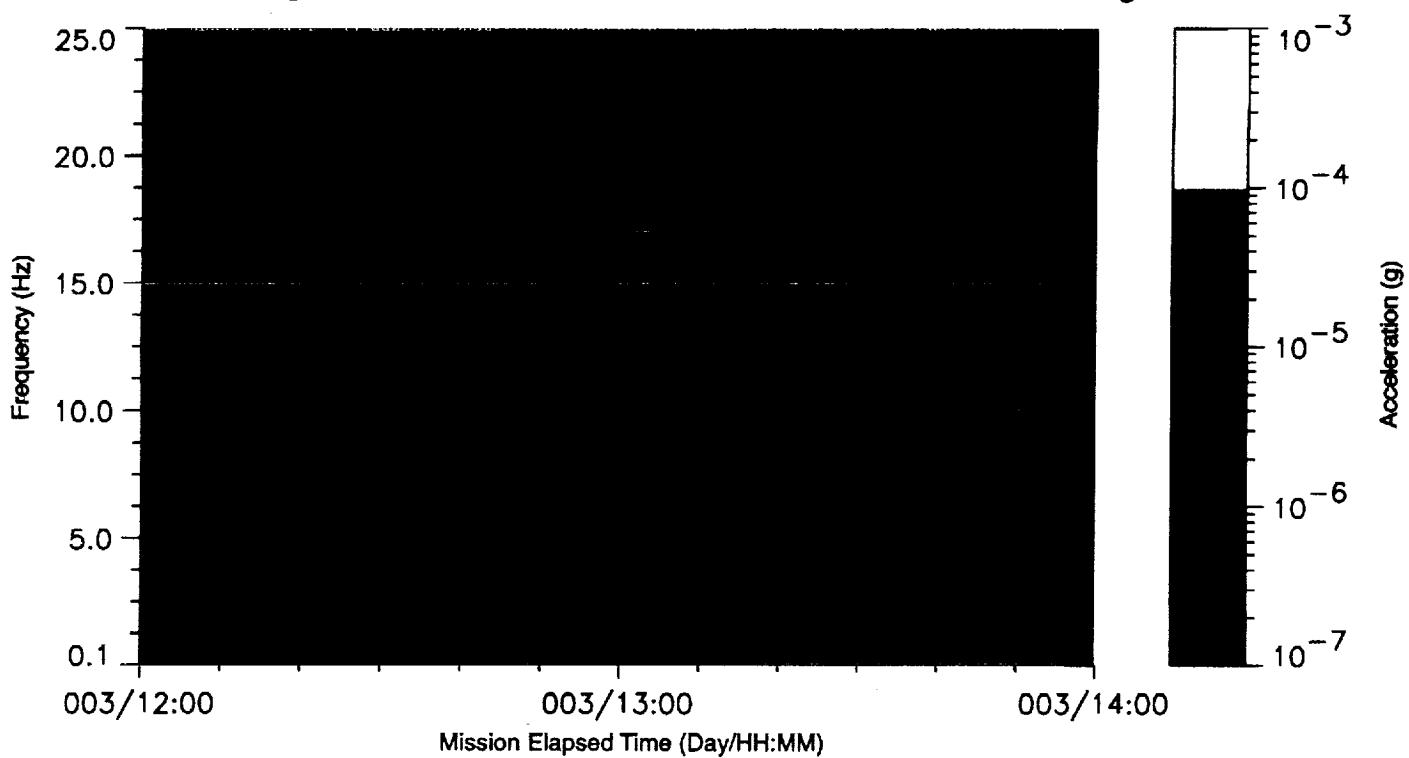
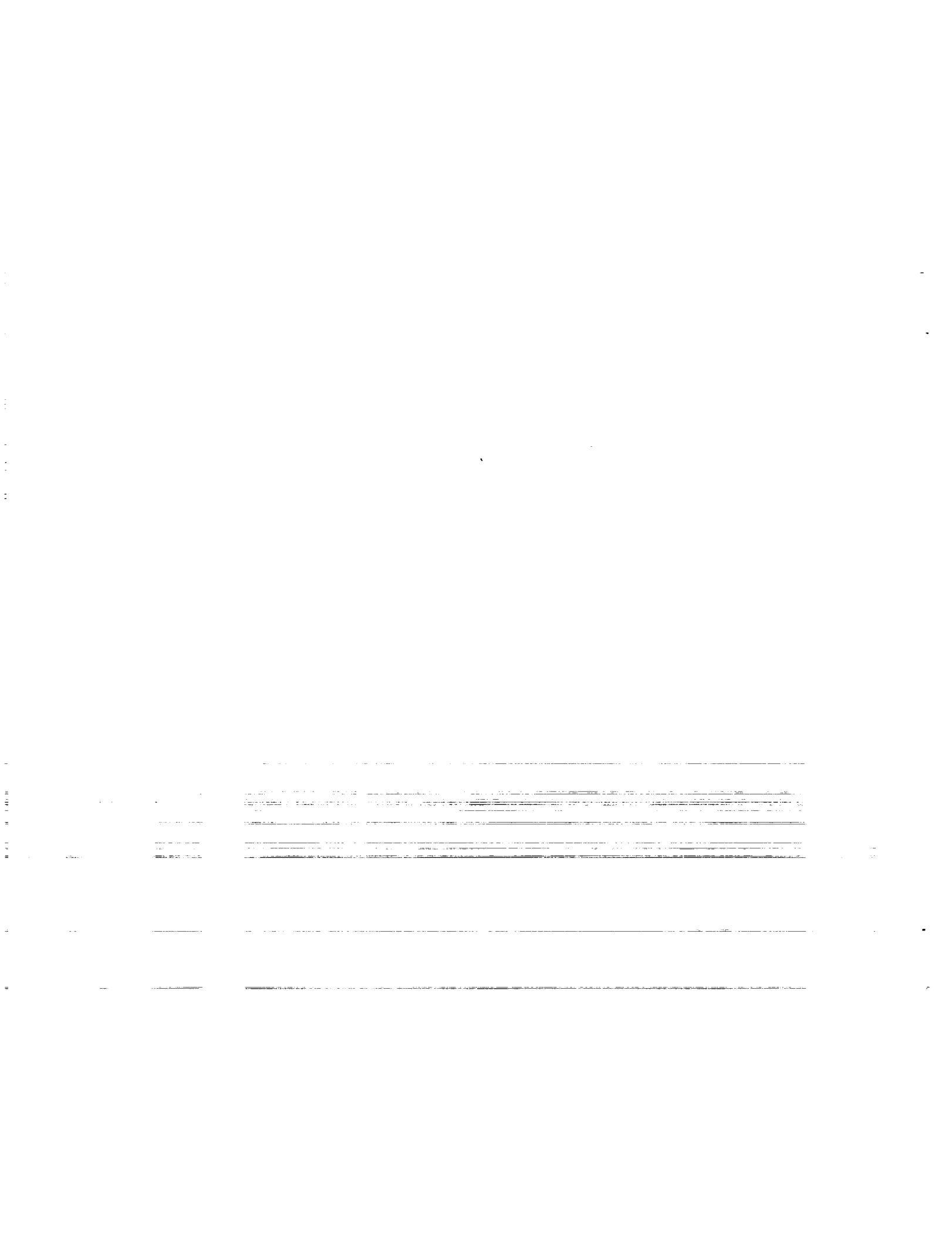


Figure C-22 USMP-2 Port Side of Orbiter Center Line, Vector Magnitude





SUMMARY REPORT OF MISSION ACCELERATION MEASUREMENTS FOR STS-62

Figure C-23 USMP-2 Port Side of Orbiter Center Line, Vector Magnitude

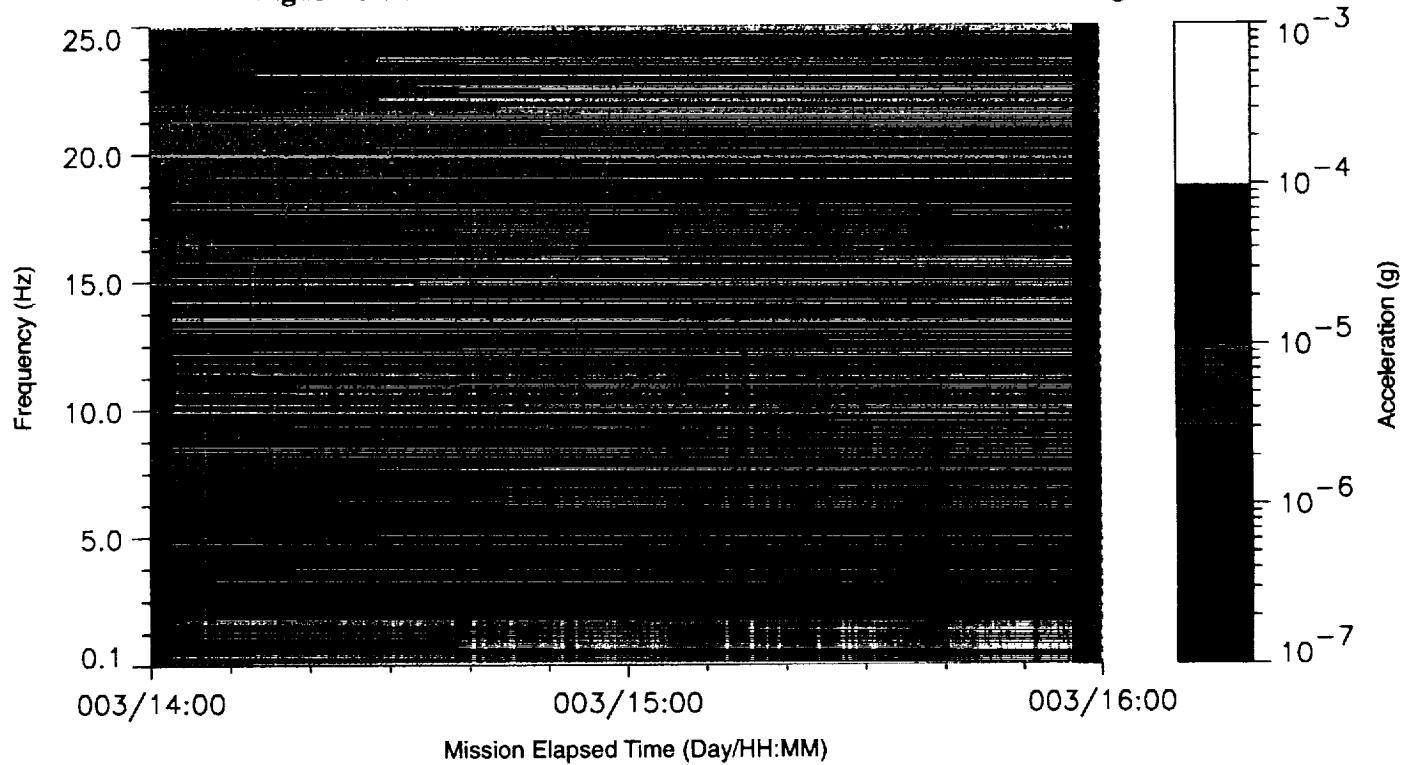
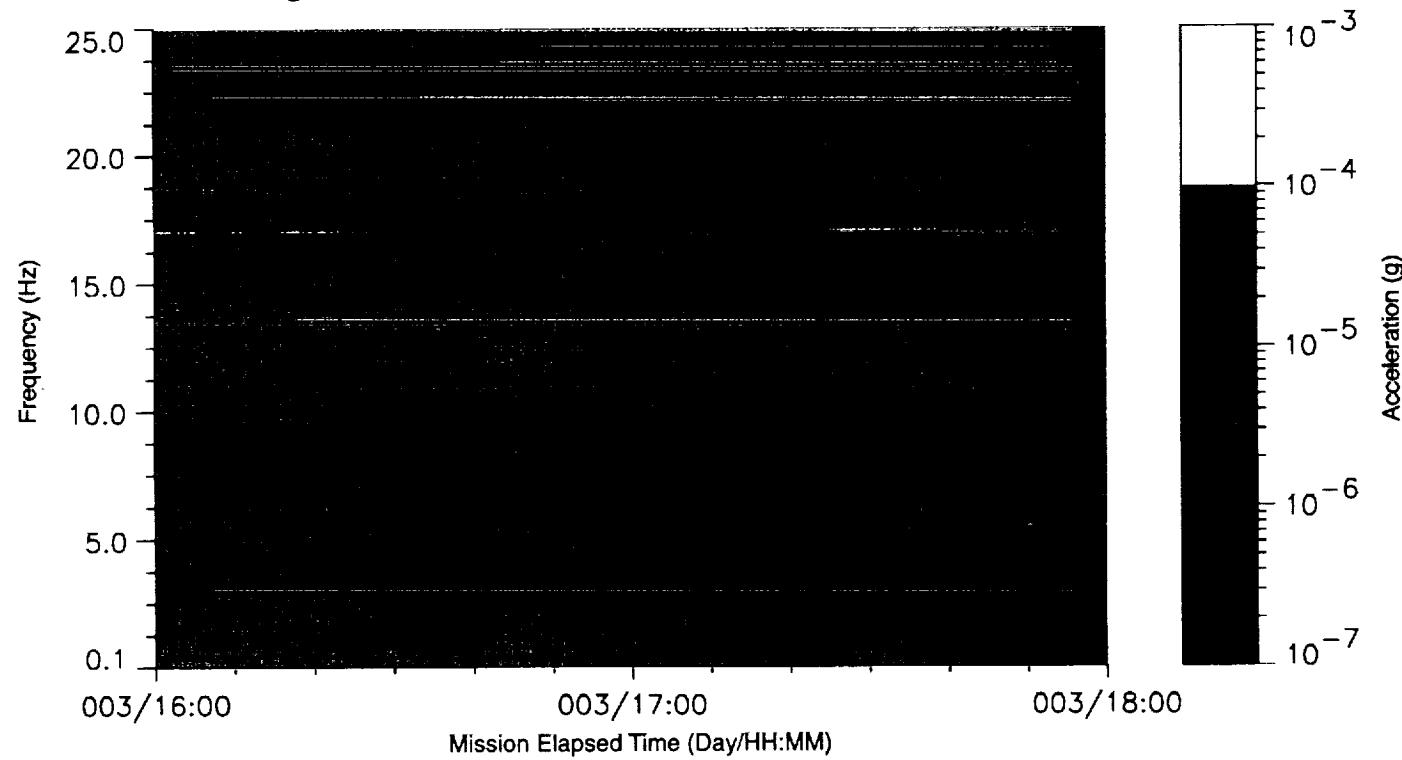
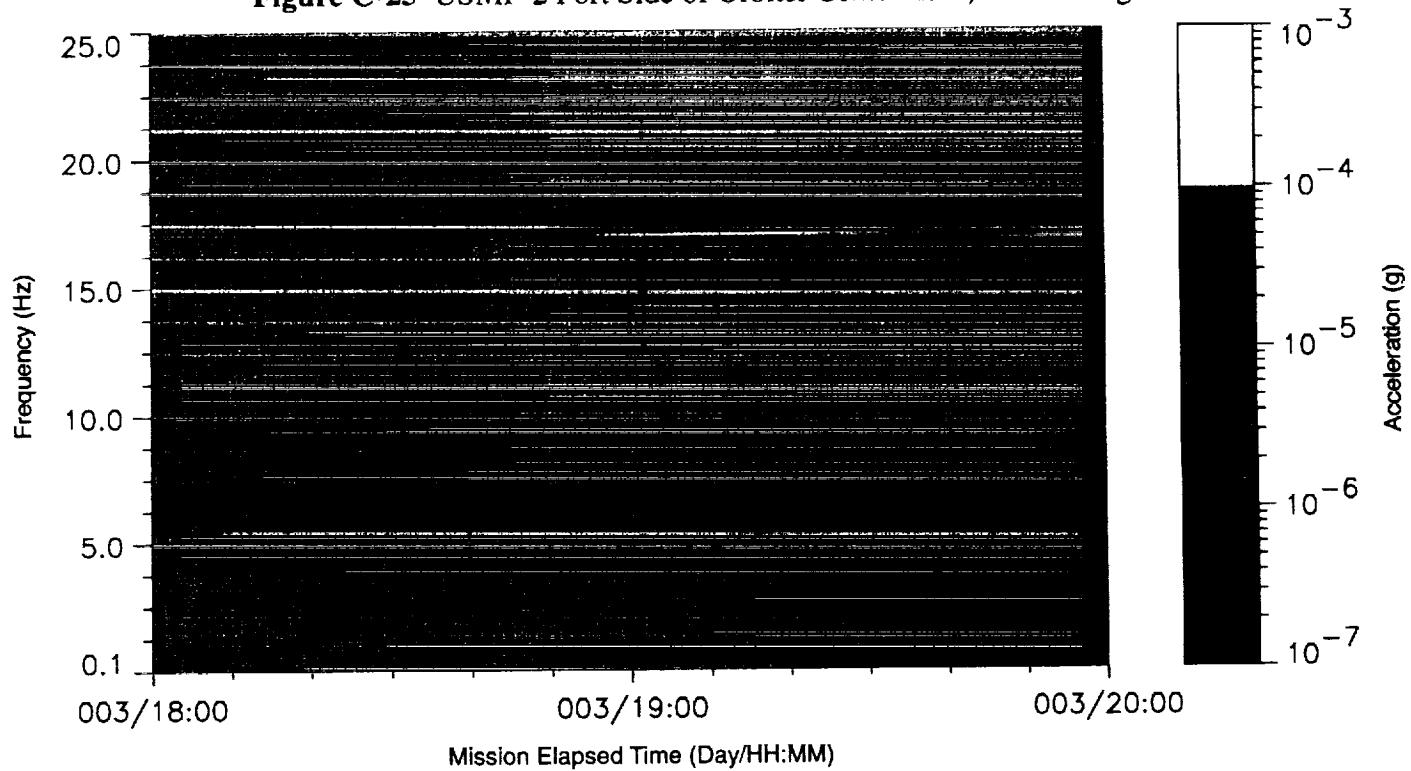


Figure C-24 USMP-2 Port Side of Orbiter Center Line, Vector Magnitude



SUMMARY REPORT OF MISSION ACCELERATION MEASUREMENTS FOR STS-62

Figure C-25 USMP-2 Port Side of Orbiter Center Line, Vector Magnitude



NO DATA AVAILABLE FOR USMP-2, UNIT F, HEAD B

FROM MET 003/20:00:00 - 004/01:27:00

SUMMARY REPORT OF MISSION ACCELERATION MEASUREMENTS FOR STS-62

Figure C-26 USMP-2 Port Side of Orbiter Center Line, Vector Magnitude

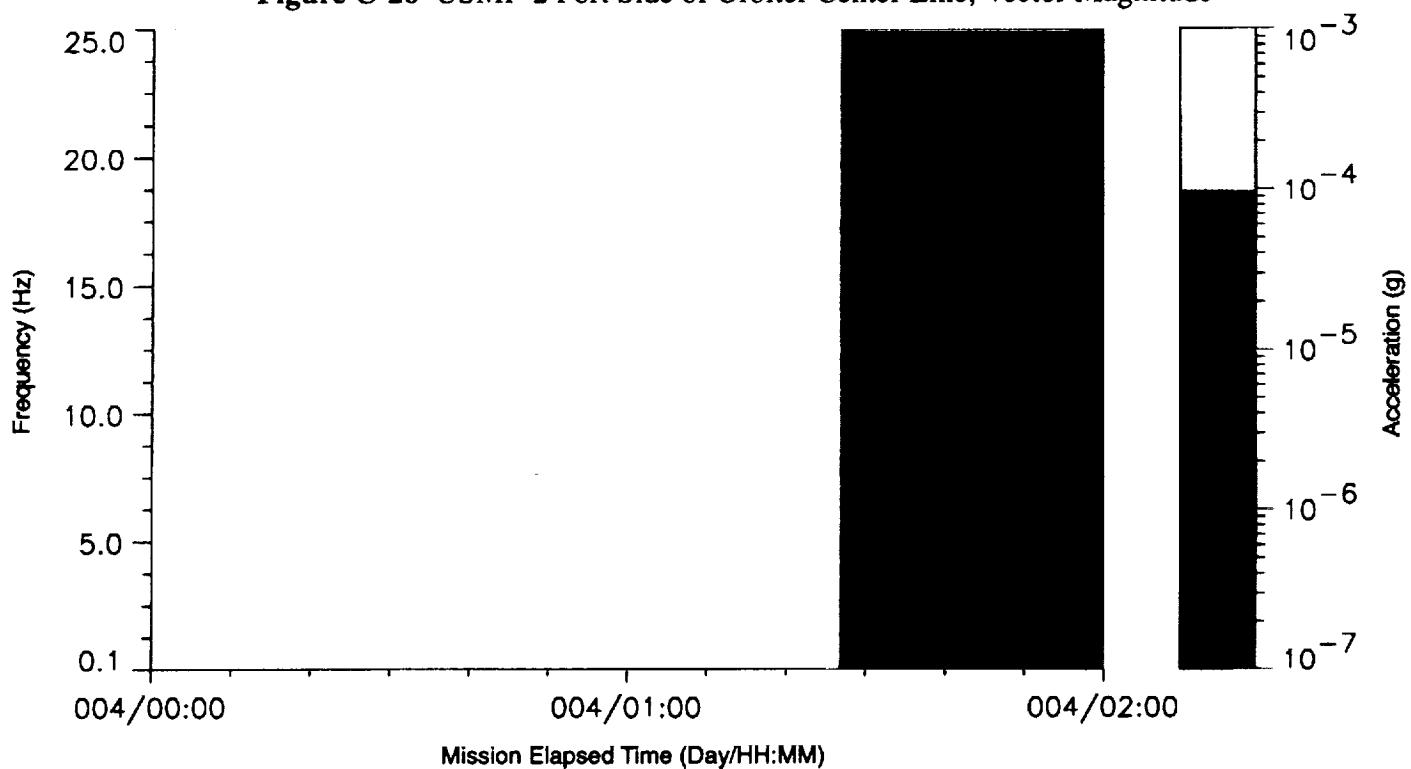
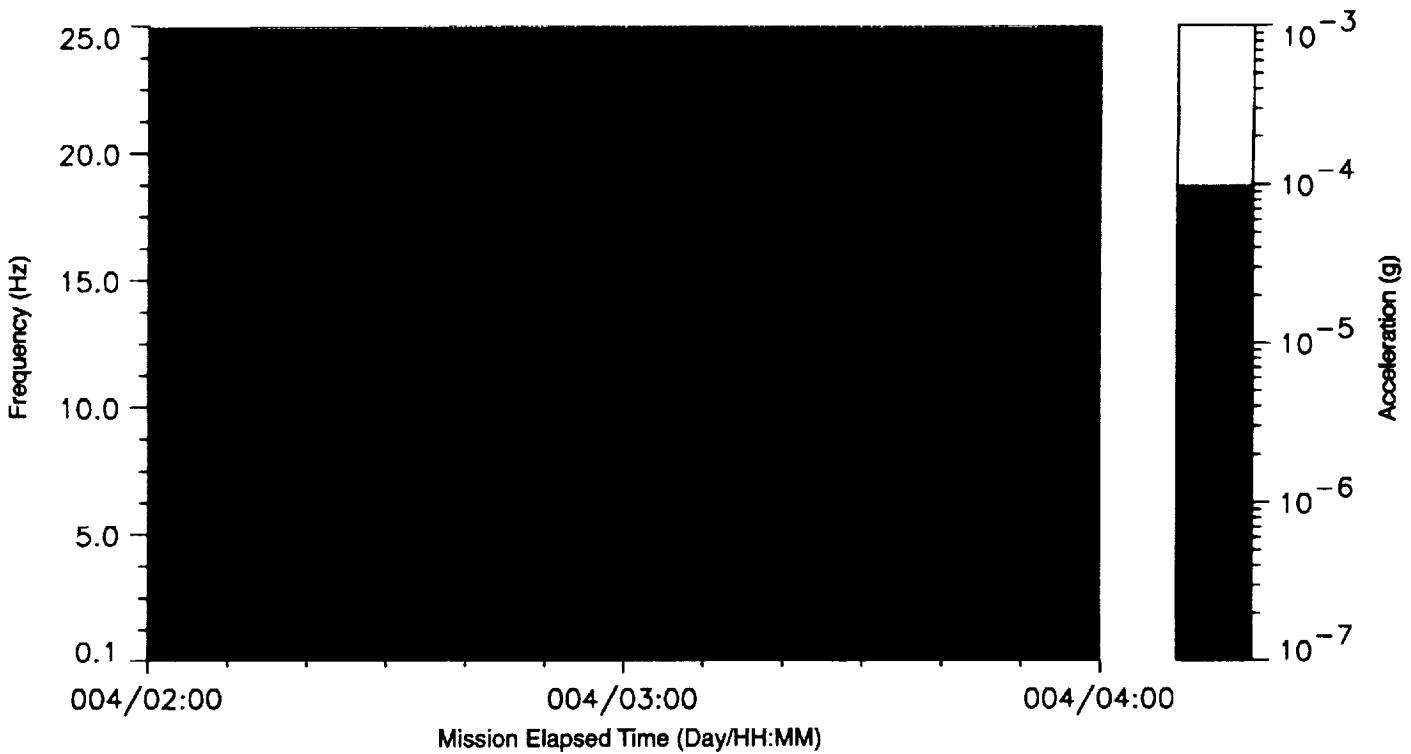


Figure C-27 USMP-2 Port Side of Orbiter Center Line, Vector Magnitude





SUMMARY REPORT OF MISSION ACCELERATION MEASUREMENTS FOR STS-62

Figure C-28 USMP-2 Port Side of Orbiter Center Line, Vector Magnitude

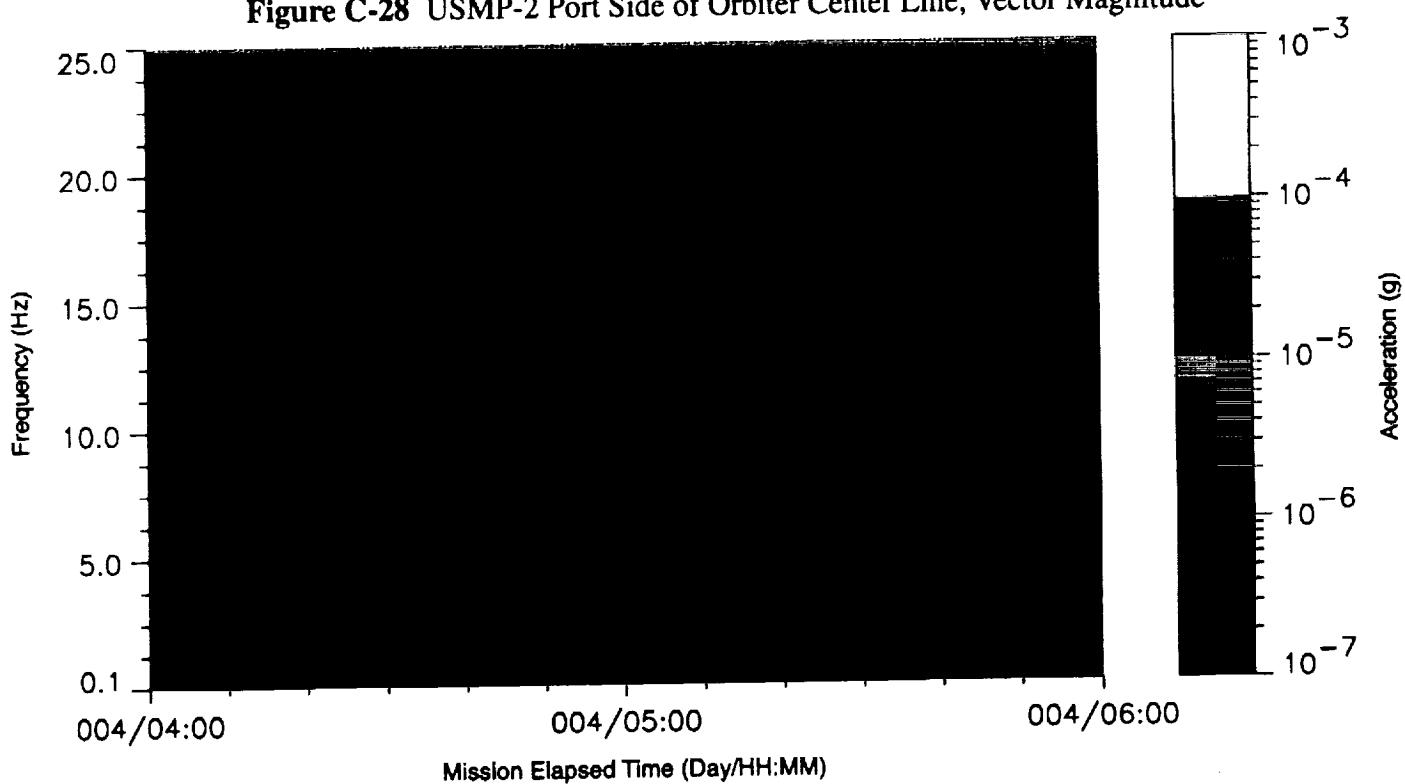
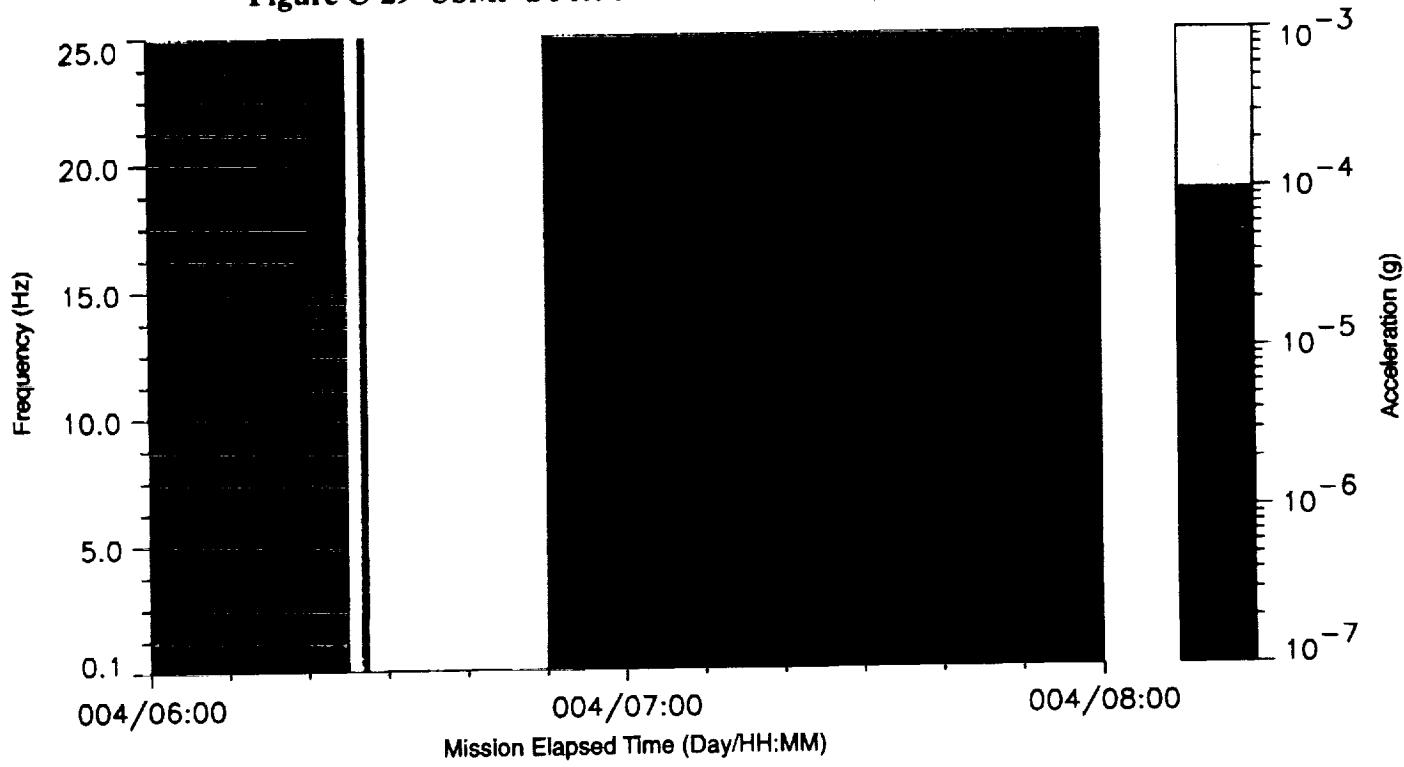
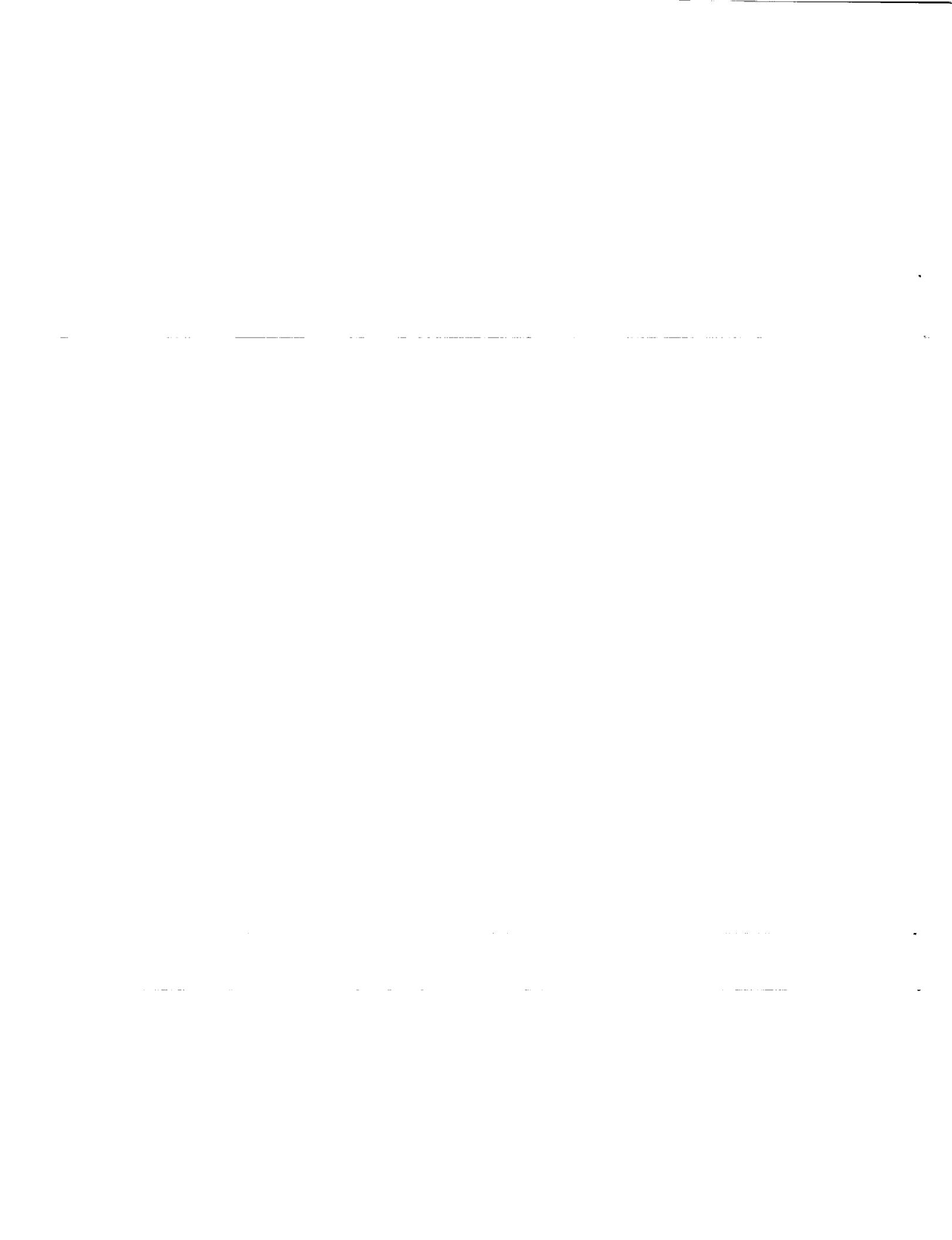


Figure C-29 USMP-2 Port Side of Orbiter Center Line, Vector Magnitude





SUMMARY REPORT OF MISSION ACCELERATION MEASUREMENTS FOR STS-62

Figure C-30 USMP-2 Port Side of Orbiter Center Line, Vector Magnitude

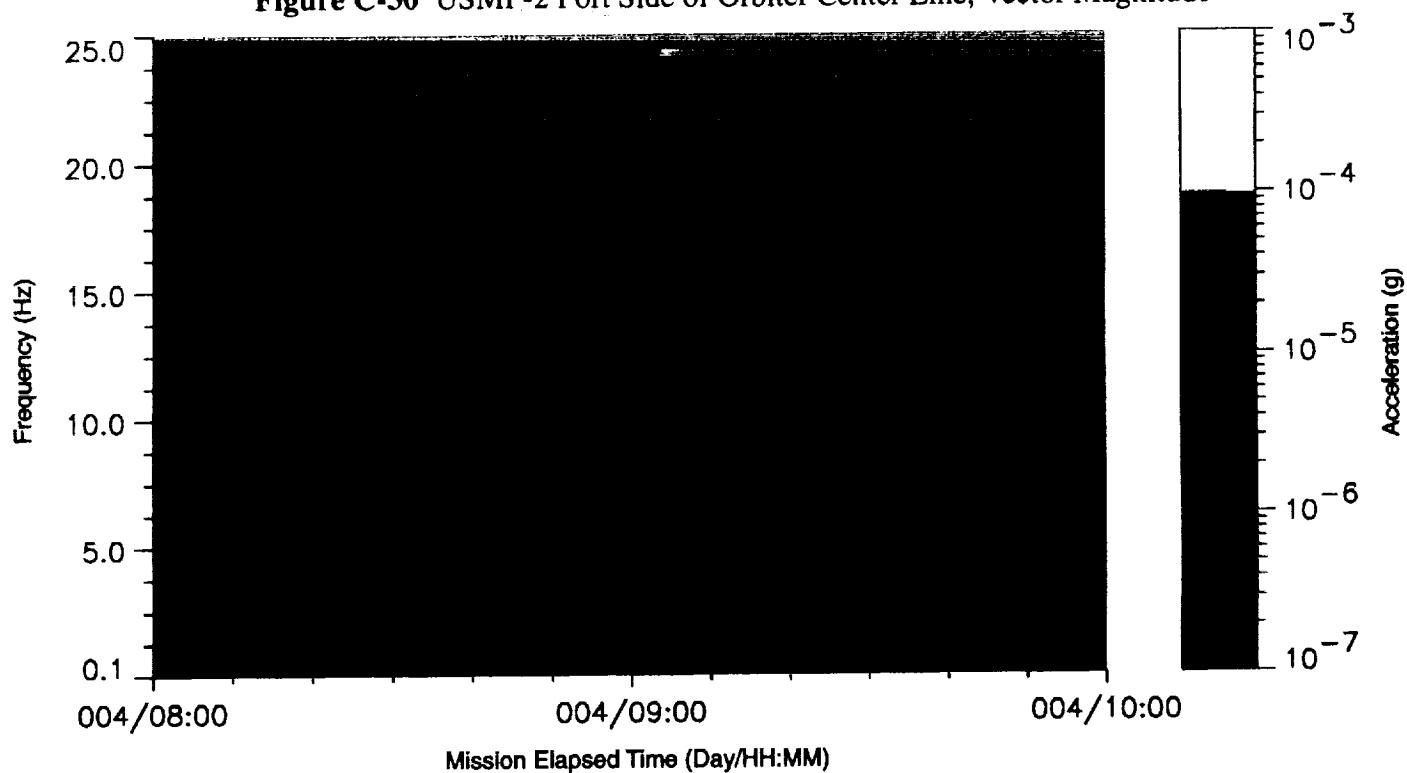
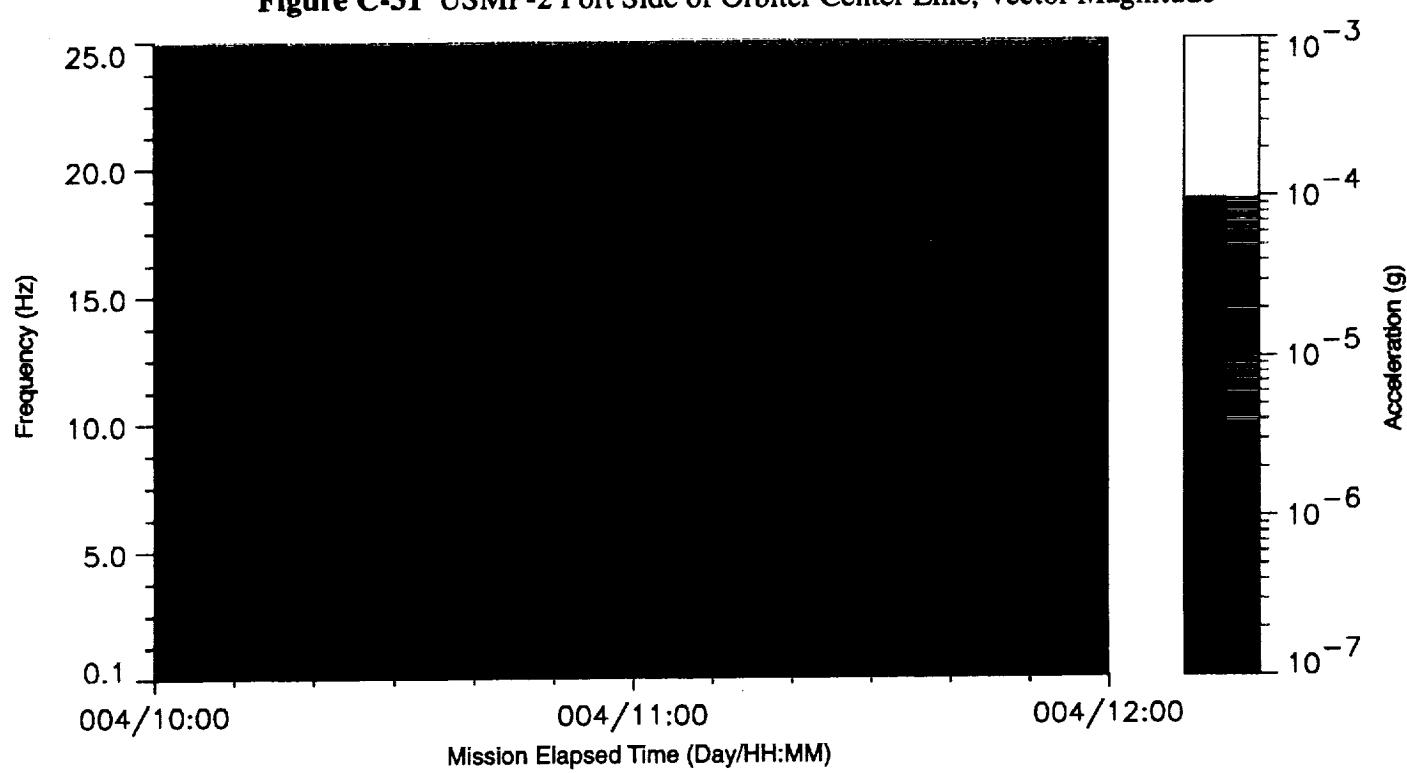


Figure C-31 USMP-2 Port Side of Orbiter Center Line, Vector Magnitude





SUMMARY REPORT OF MISSION ACCELERATION MEASUREMENTS FOR STS-62

Figure C-32 USMP-2 Port Side of Orbiter Center Line, Vector Magnitude

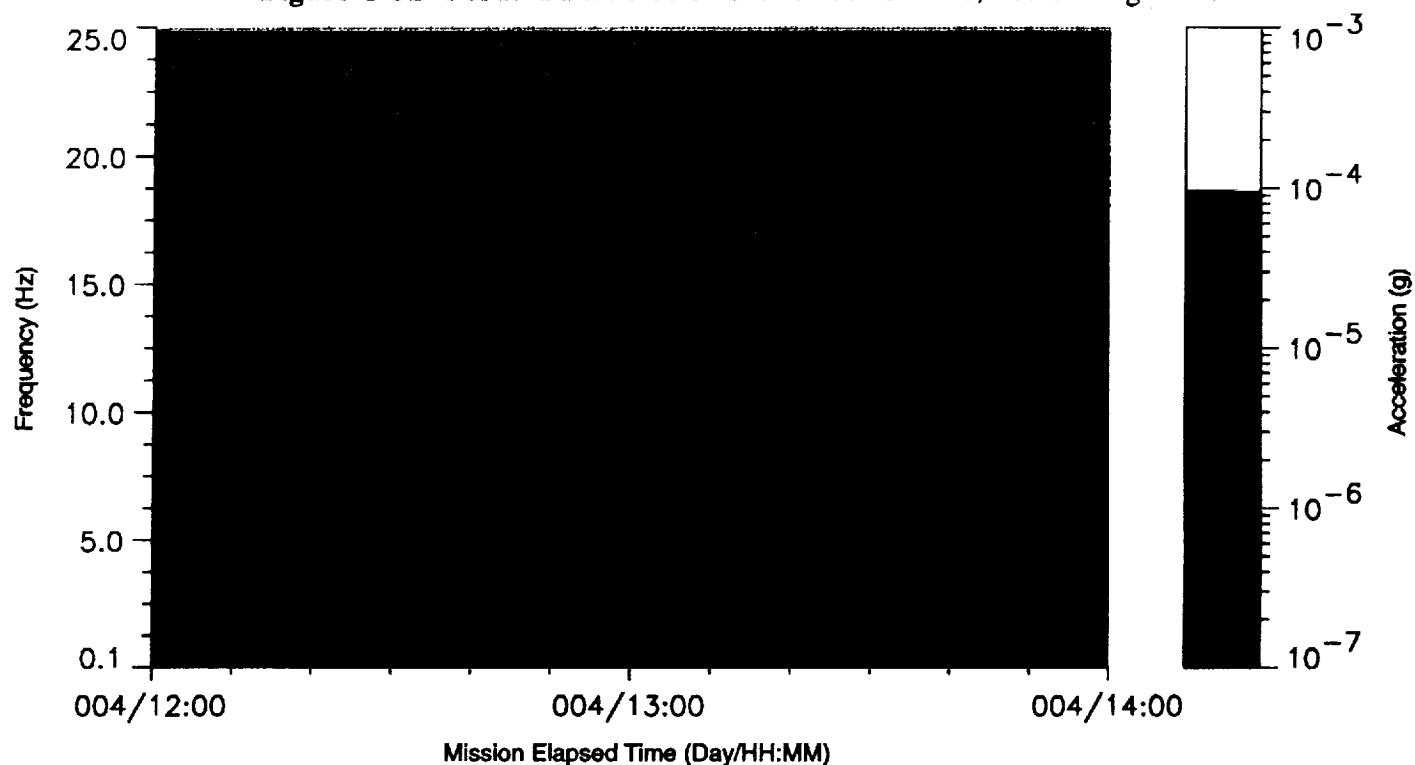
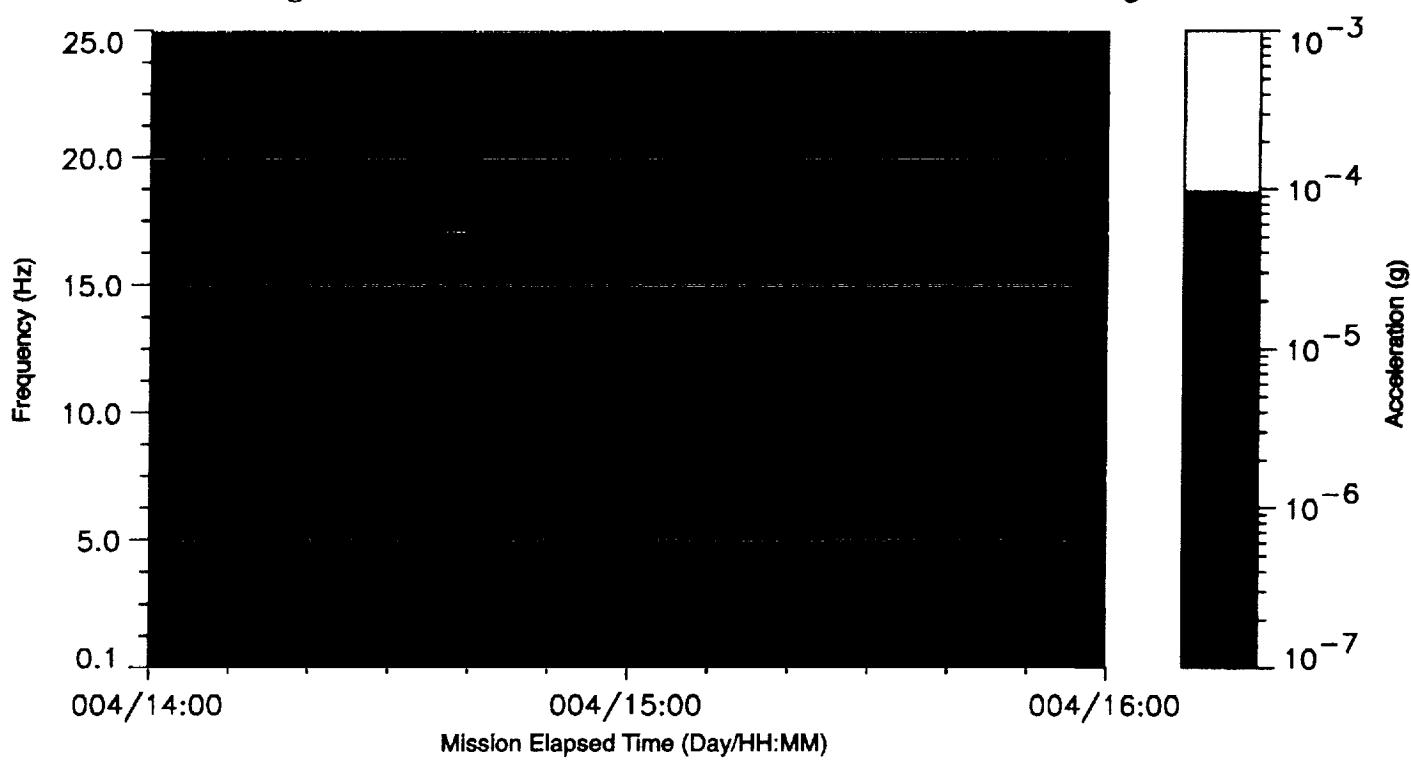


Figure C-33 USMP-2 Port Side of Orbiter Center Line, Vector Magnitude



SUMMARY REPORT OF MISSION ACCELERATION MEASUREMENTS FOR STS-62

Figure C-34 USMP-2 Port Side of Orbiter Center Line, Vector Magnitude

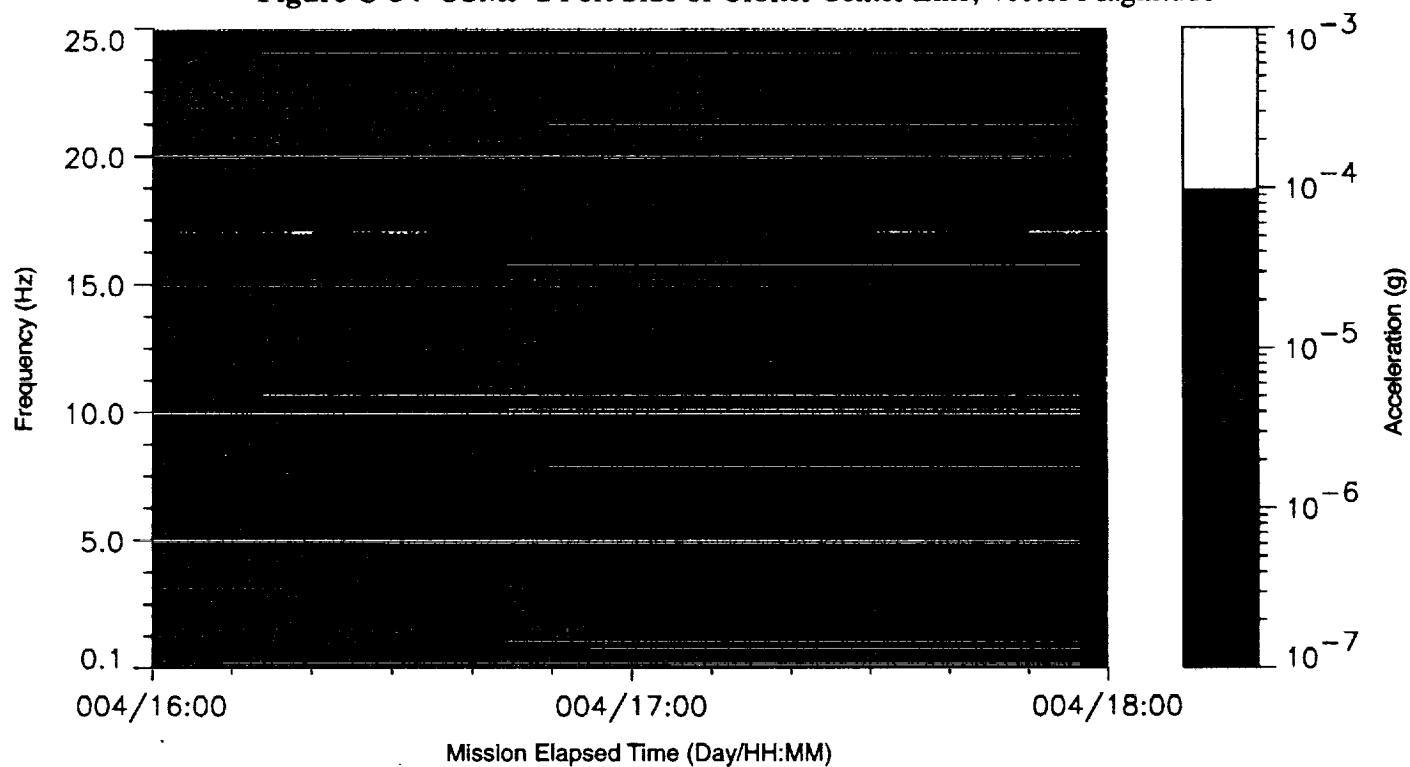
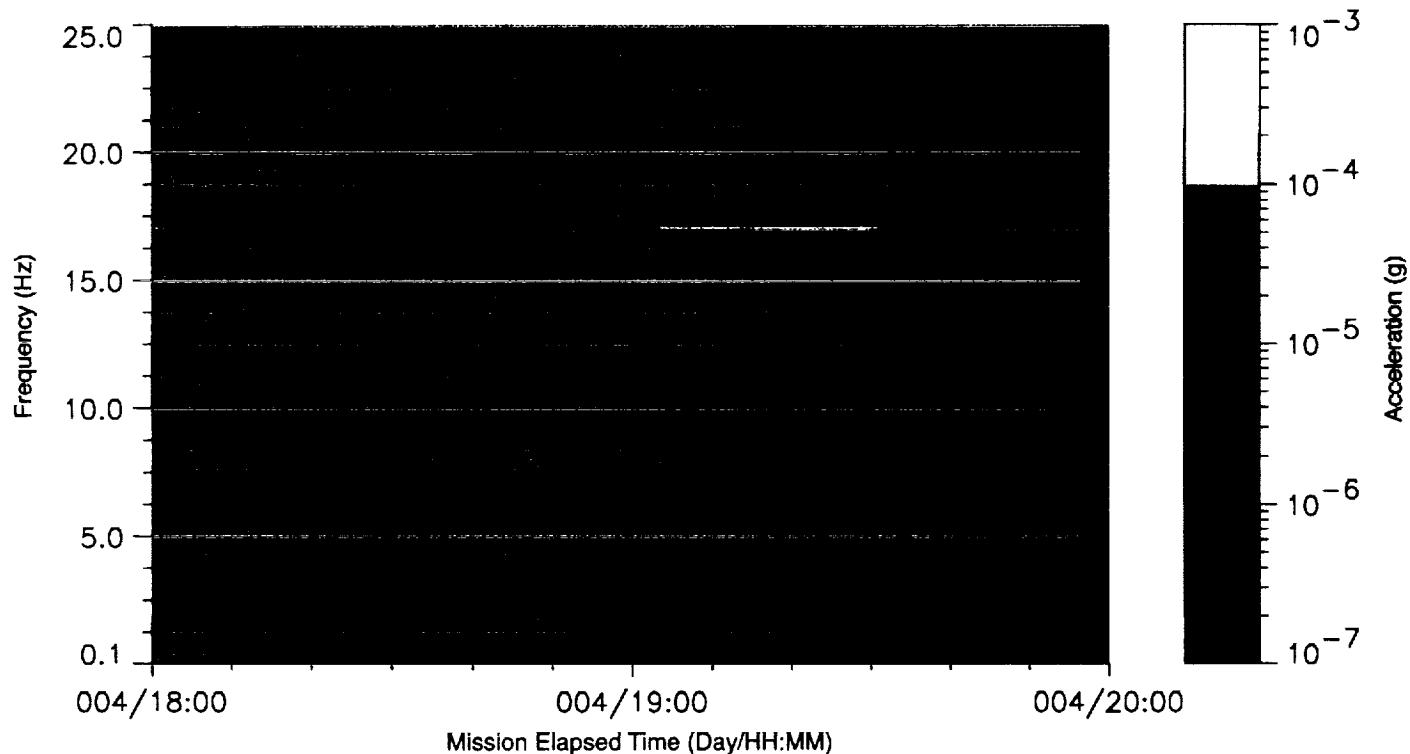


Figure C-35 USMP-2 Port Side of Orbiter Center Line, Vector Magnitude



SUMMARY REPORT OF MISSION ACCELERATION MEASUREMENTS FOR STS-62

Figure C-36 USMP-2 Port Side of Orbiter Center Line, Vector Magnitude

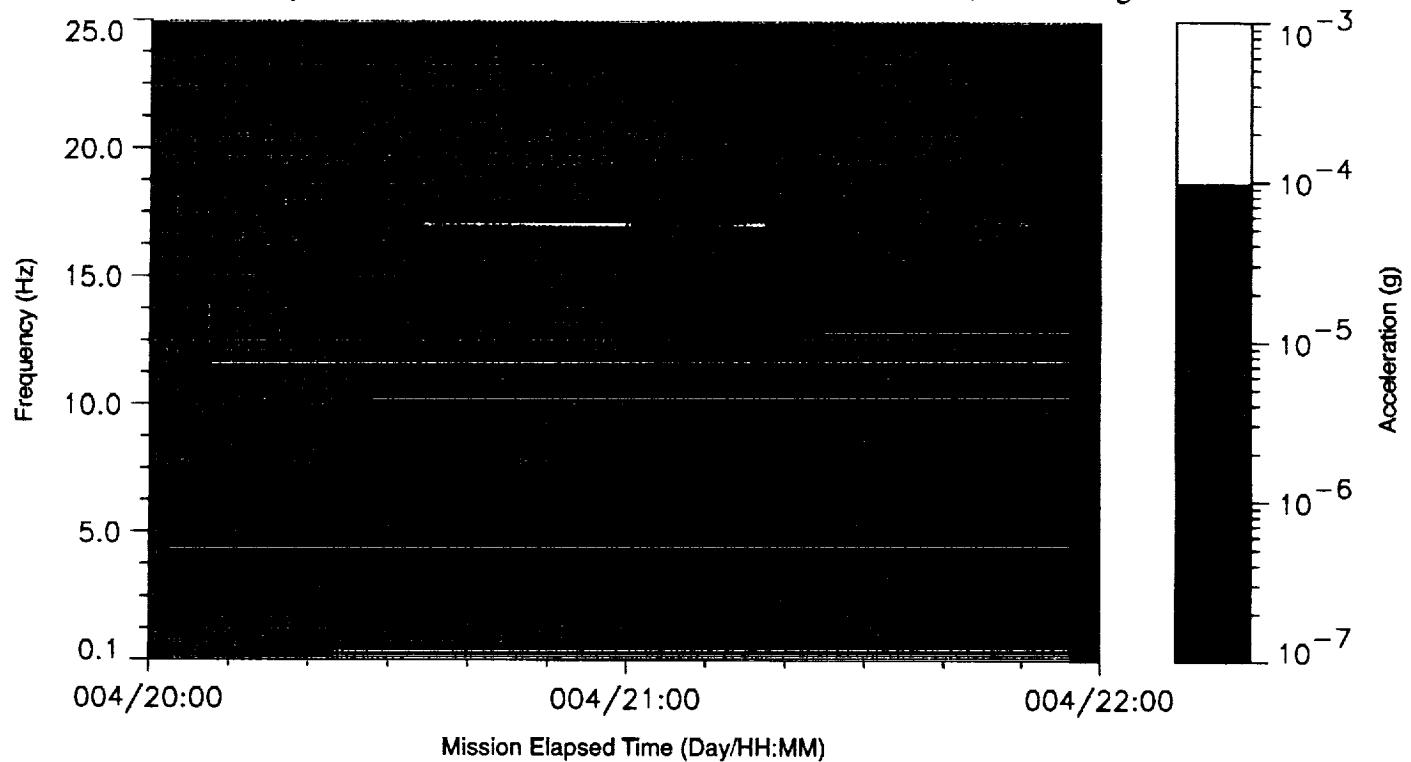
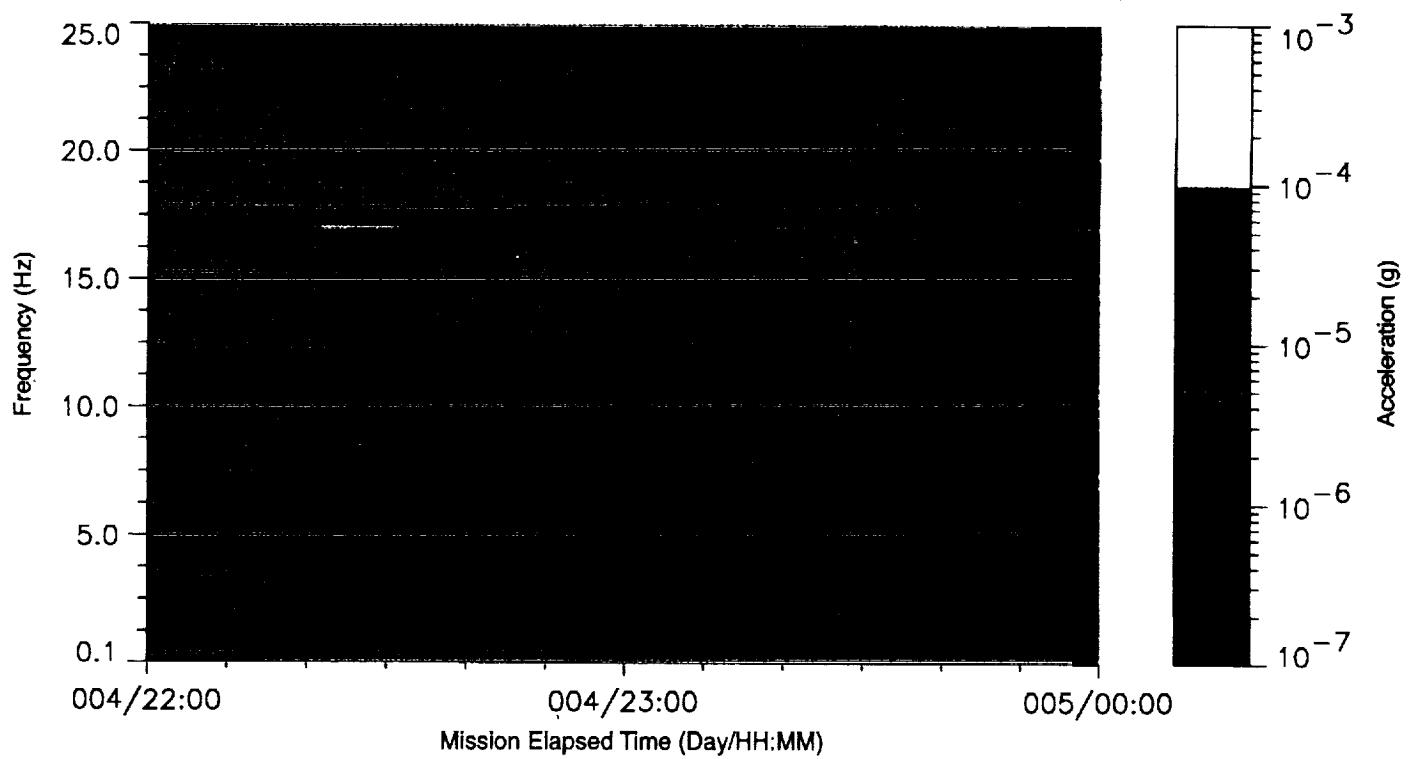
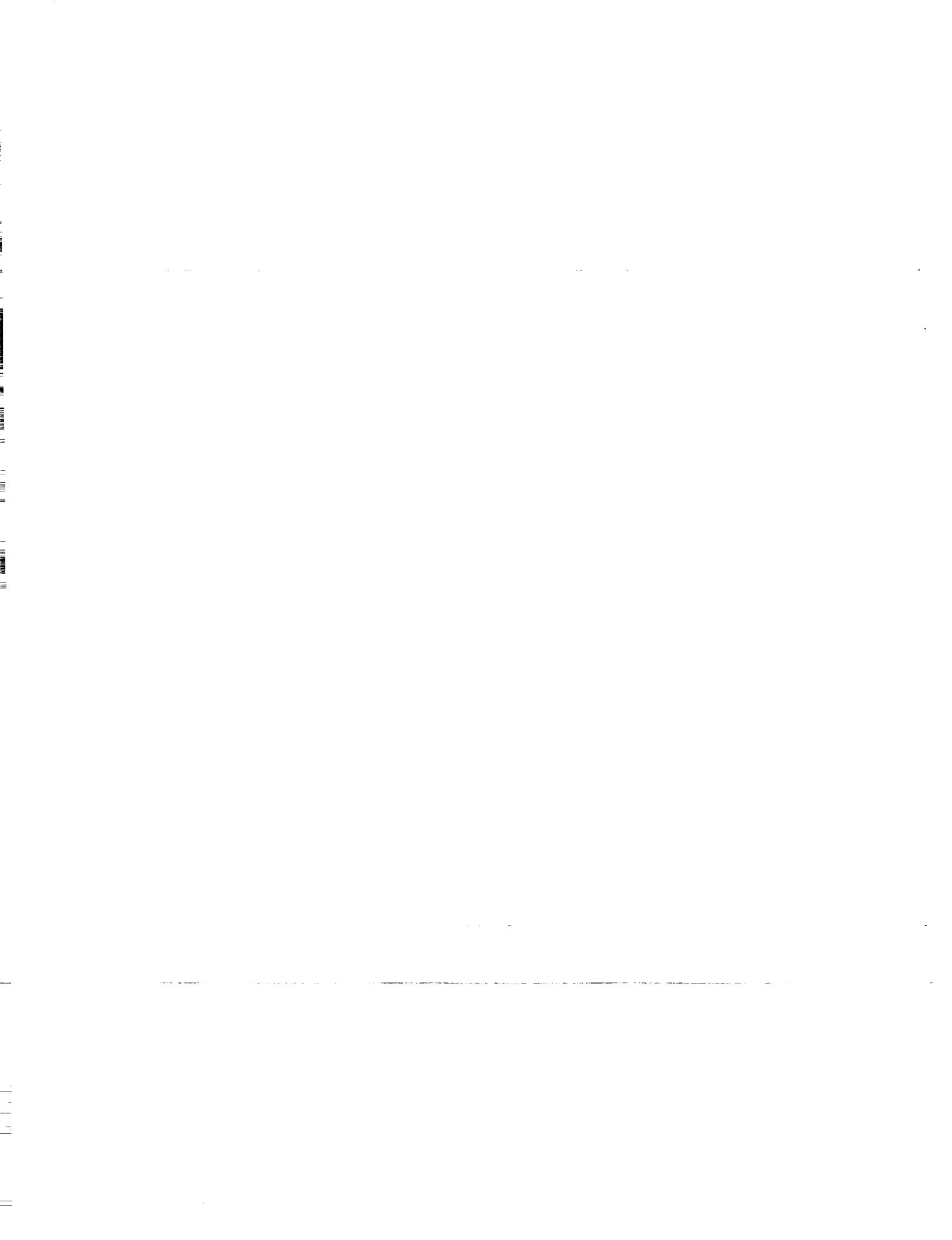


Figure C-37 USMP-2 Port Side of Orbiter Center Line, Vector Magnitude





SUMMARY REPORT OF MISSION ACCELERATION MEASUREMENTS FOR STS-62

Figure C-38 USMP-2 Port Side of Orbiter Center Line, Vector Magnitude

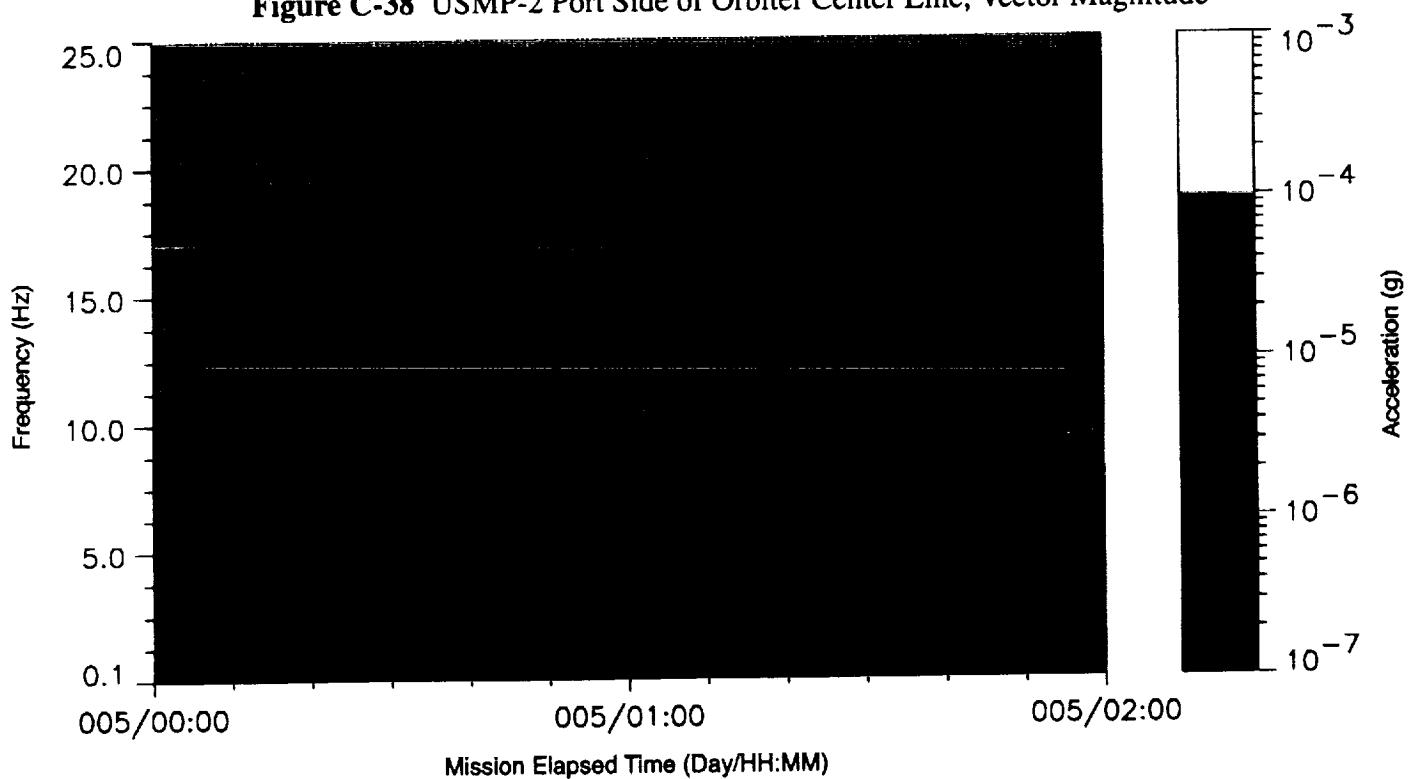
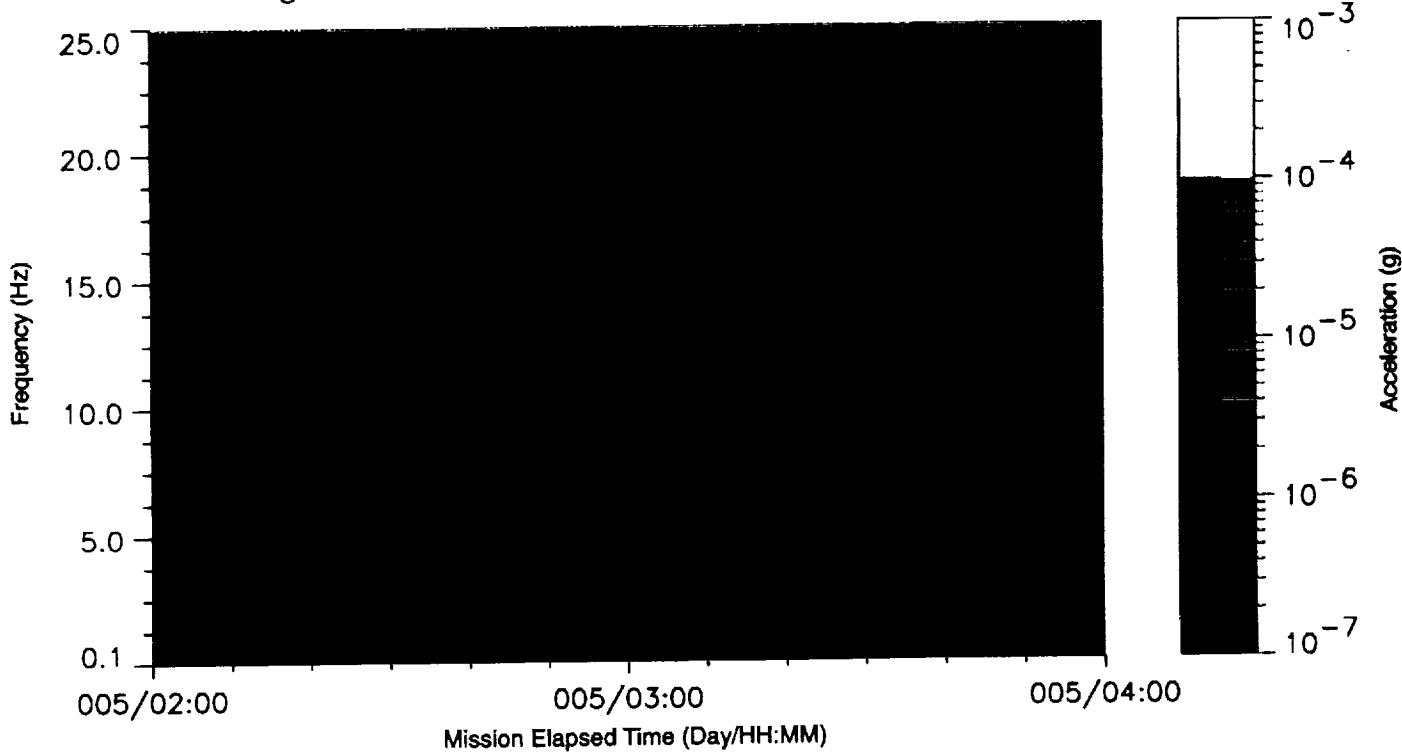
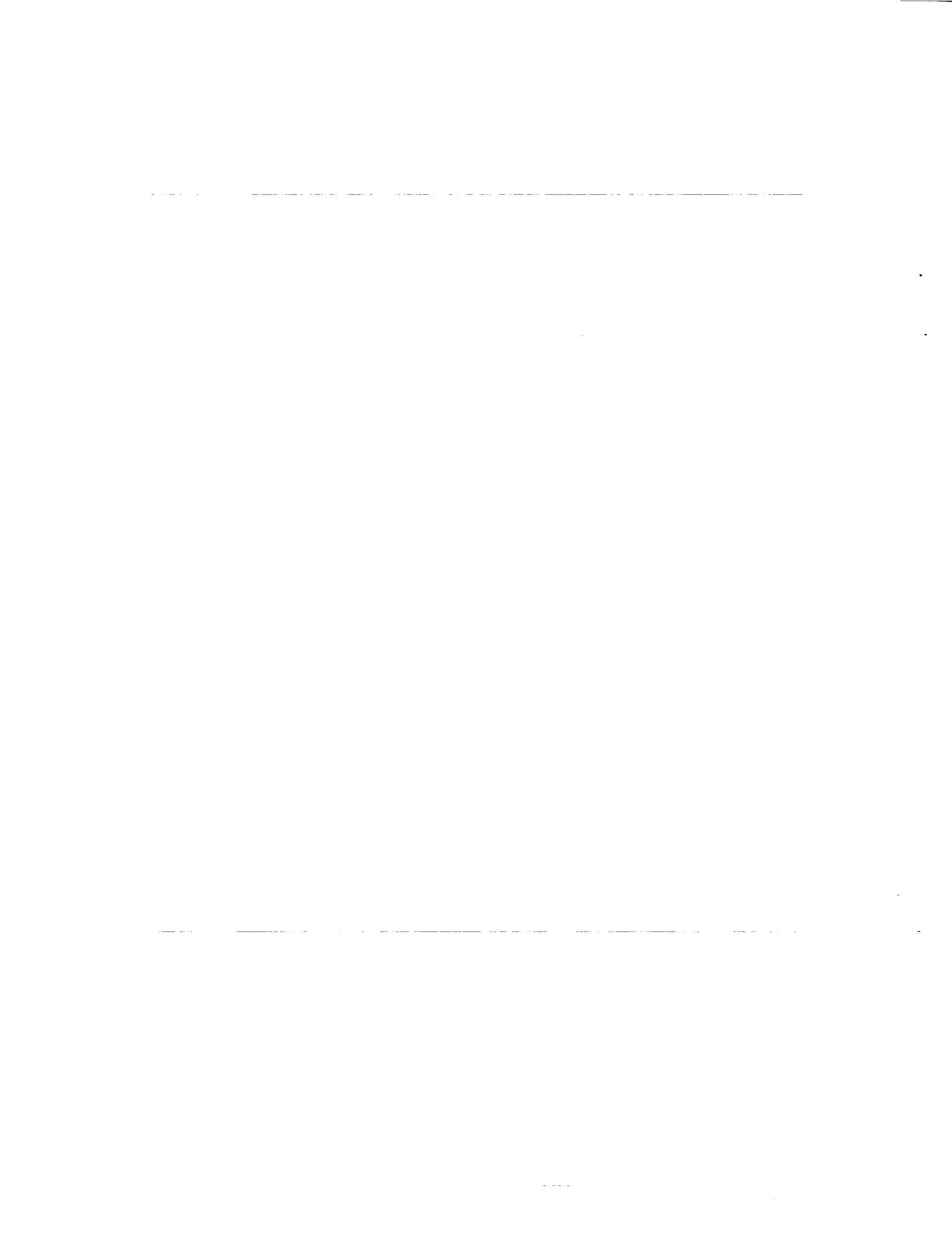


Figure C-39 USMP-2 Port Side of Orbiter Center Line, Vector Magnitude





SUMMARY REPORT OF MISSION ACCELERATION MEASUREMENTS FOR STS-62

Figure C-42 USMP-2 Port Side of Orbiter Center Line, Vector Magnitude

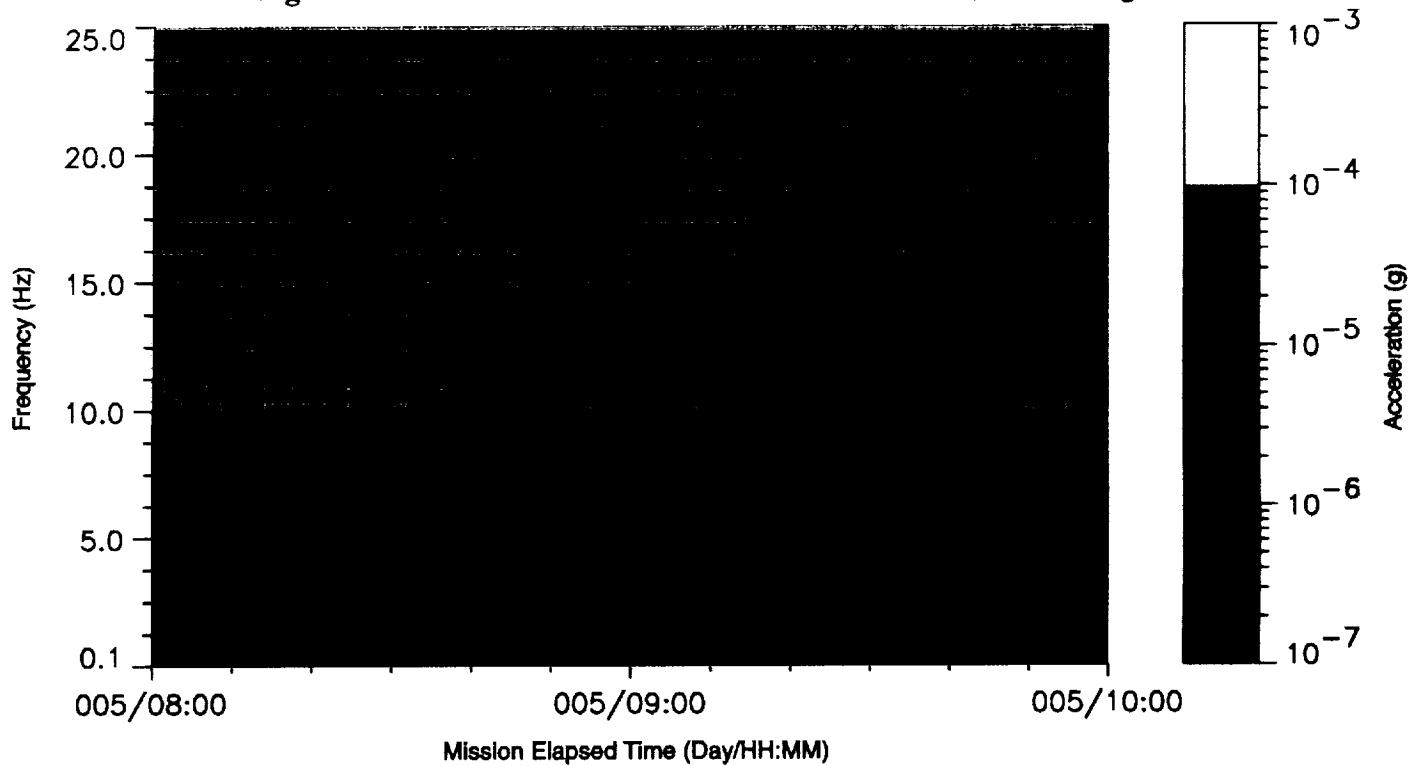
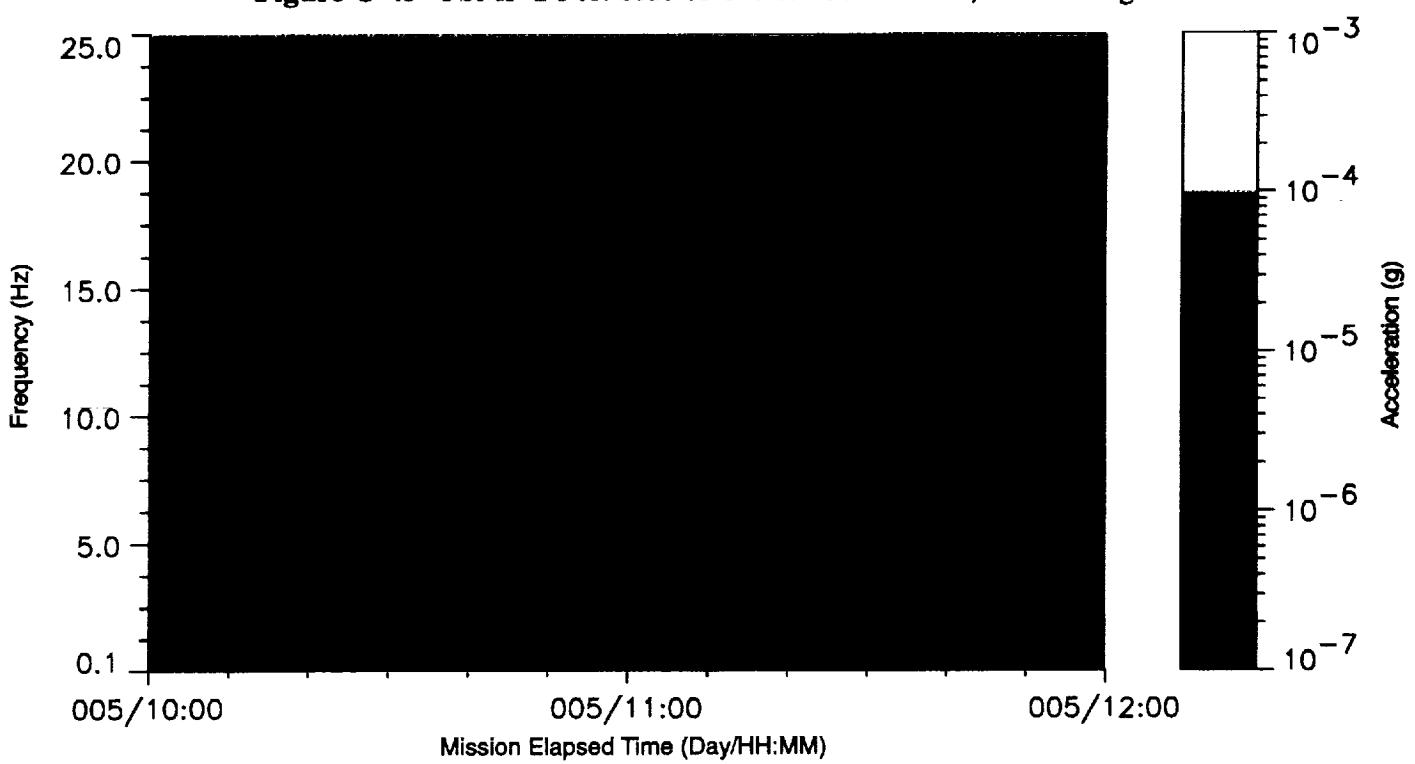


Figure C-43 USMP-2 Port Side of Orbiter Center Line, Vector Magnitude





SUMMARY REPORT OF MISSION ACCELERATION MEASUREMENTS FOR STS-62

Figure C-44 USMP-2 Port Side of Orbiter Center Line, Vector Magnitude

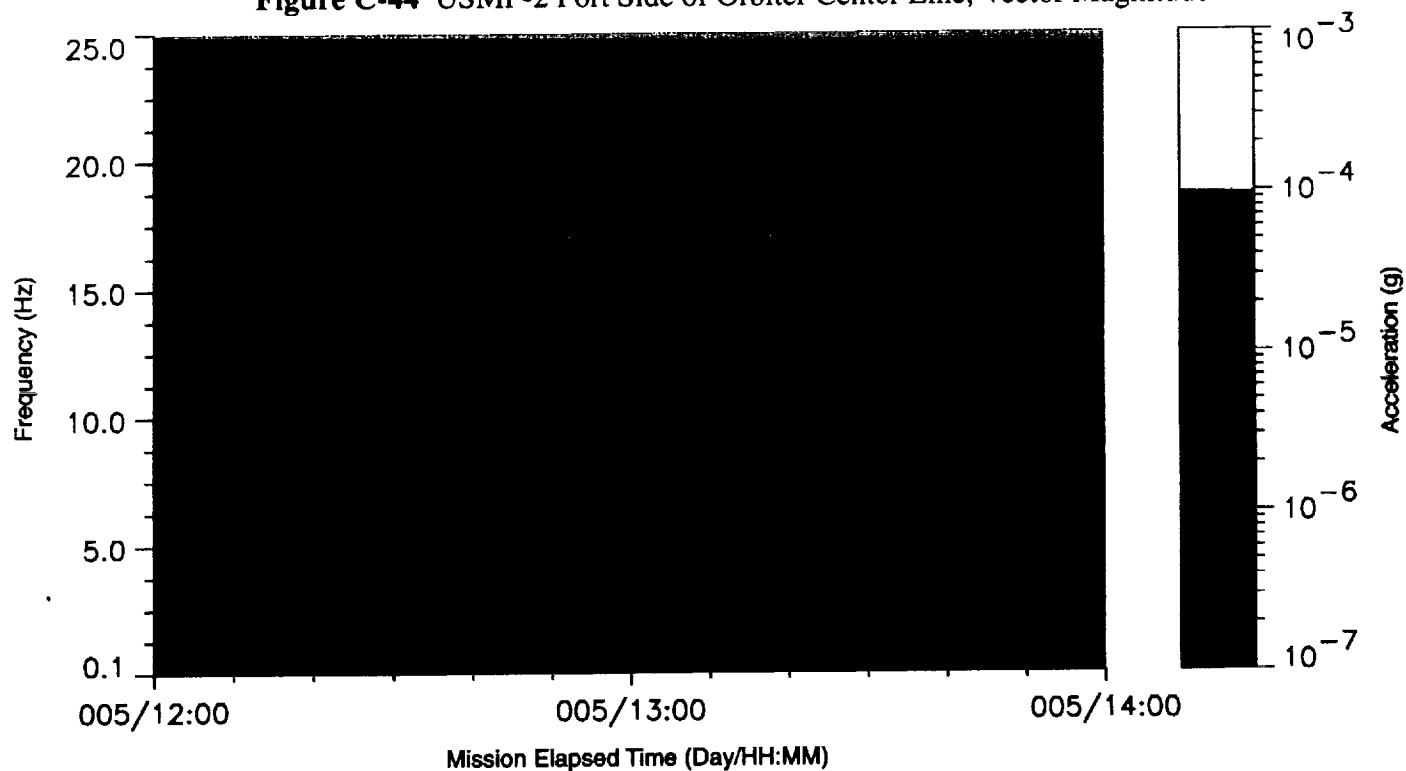
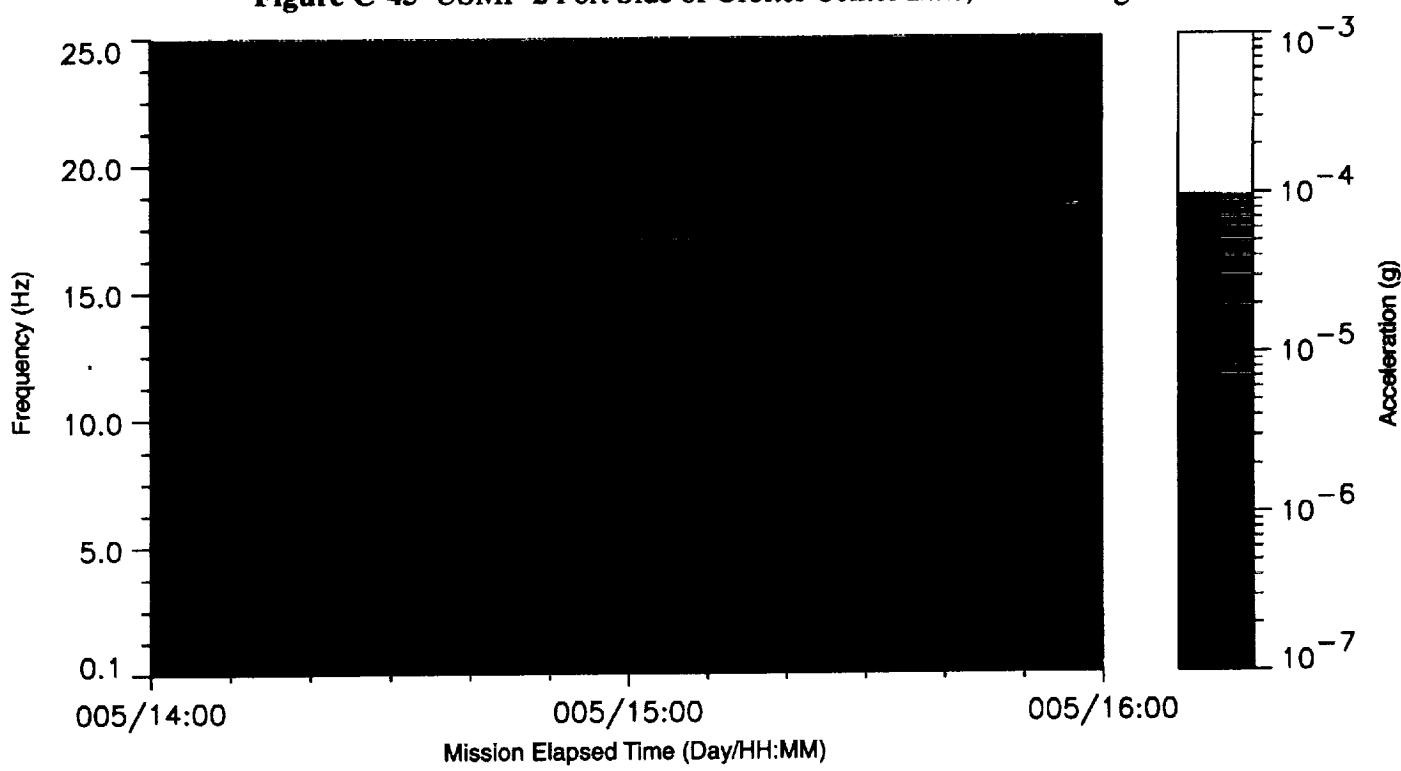
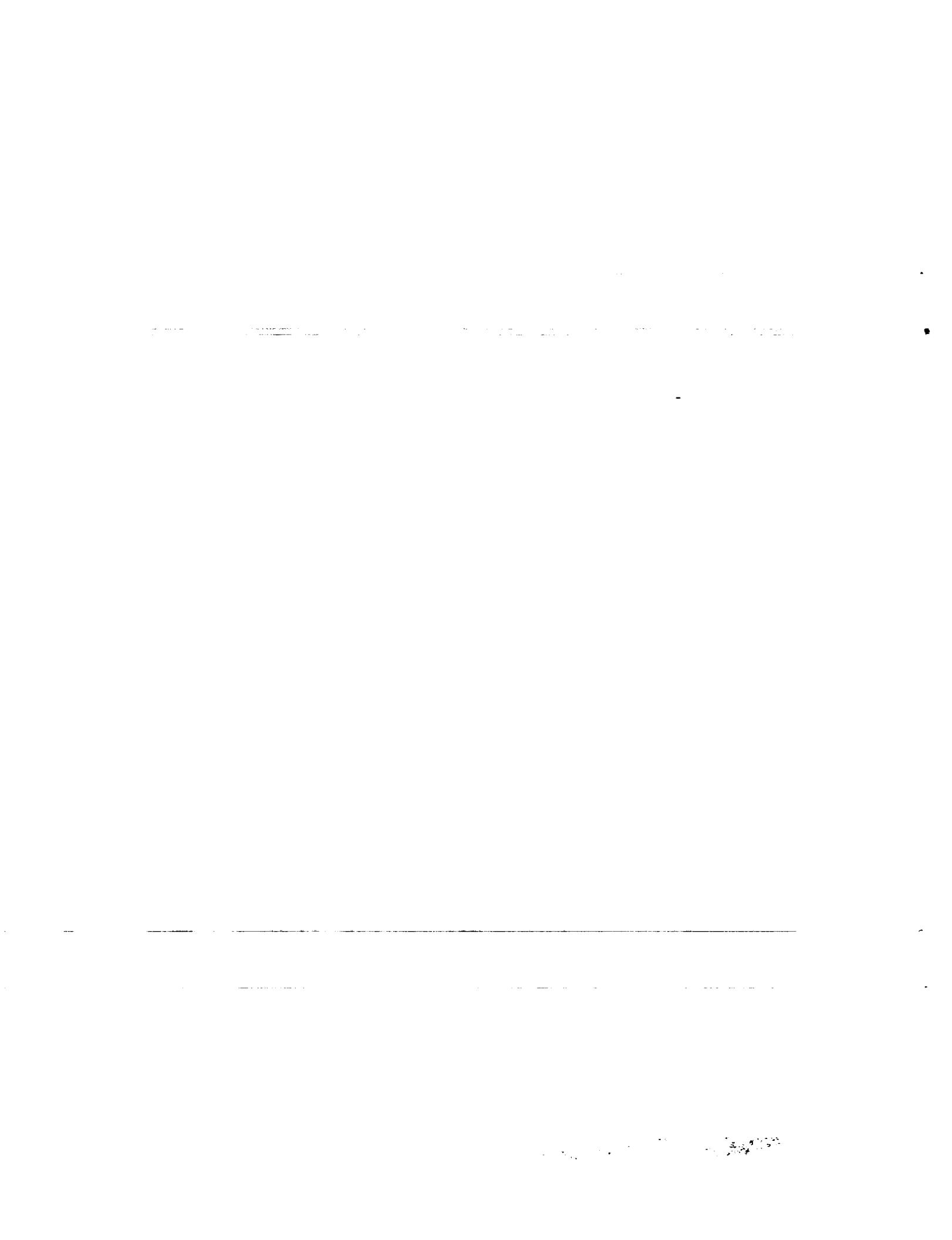


Figure C-45 USMP-2 Port Side of Orbiter Center Line, Vector Magnitude





SUMMARY REPORT OF MISSION ACCELERATION MEASUREMENTS FOR STS-62

Figure C-46 USMP-2 Port Side of Orbiter Center Line, Vector Magnitude

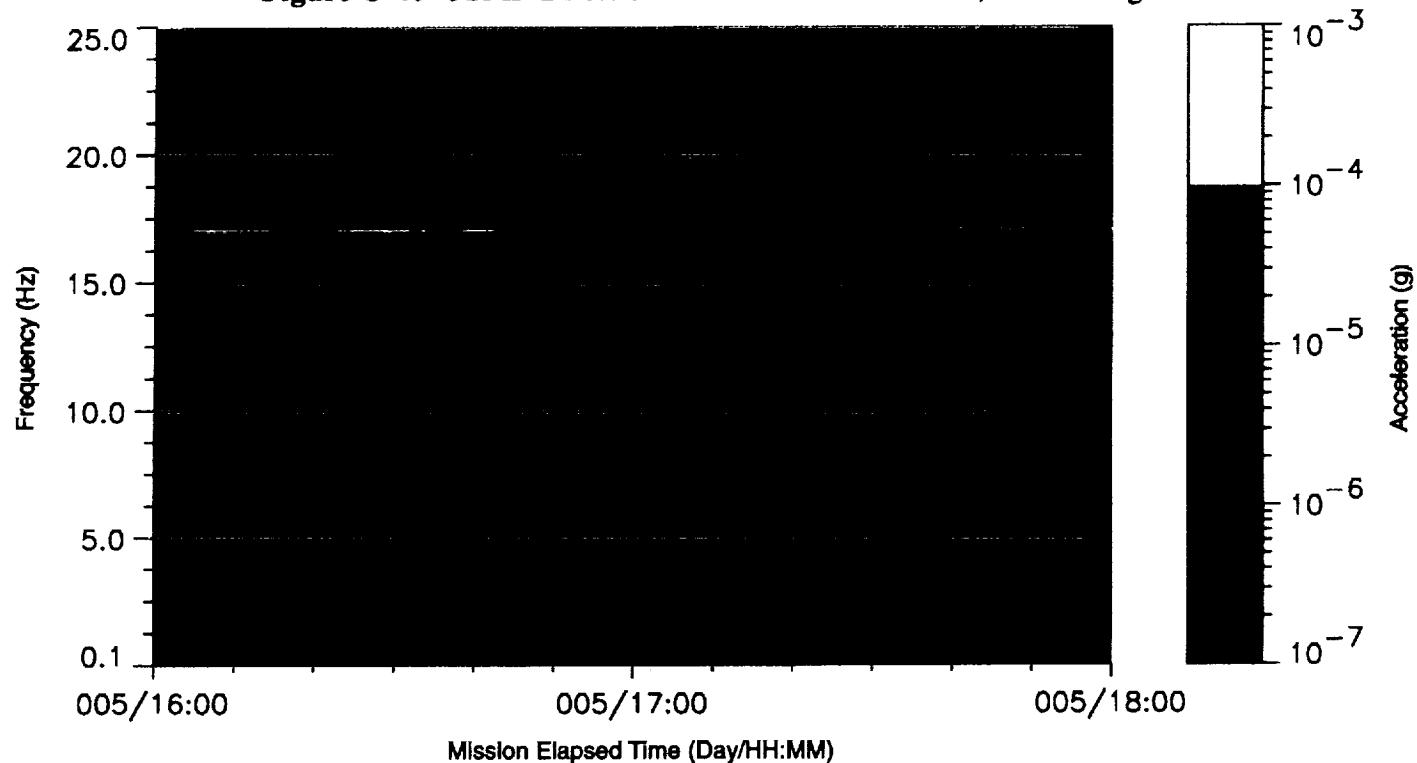
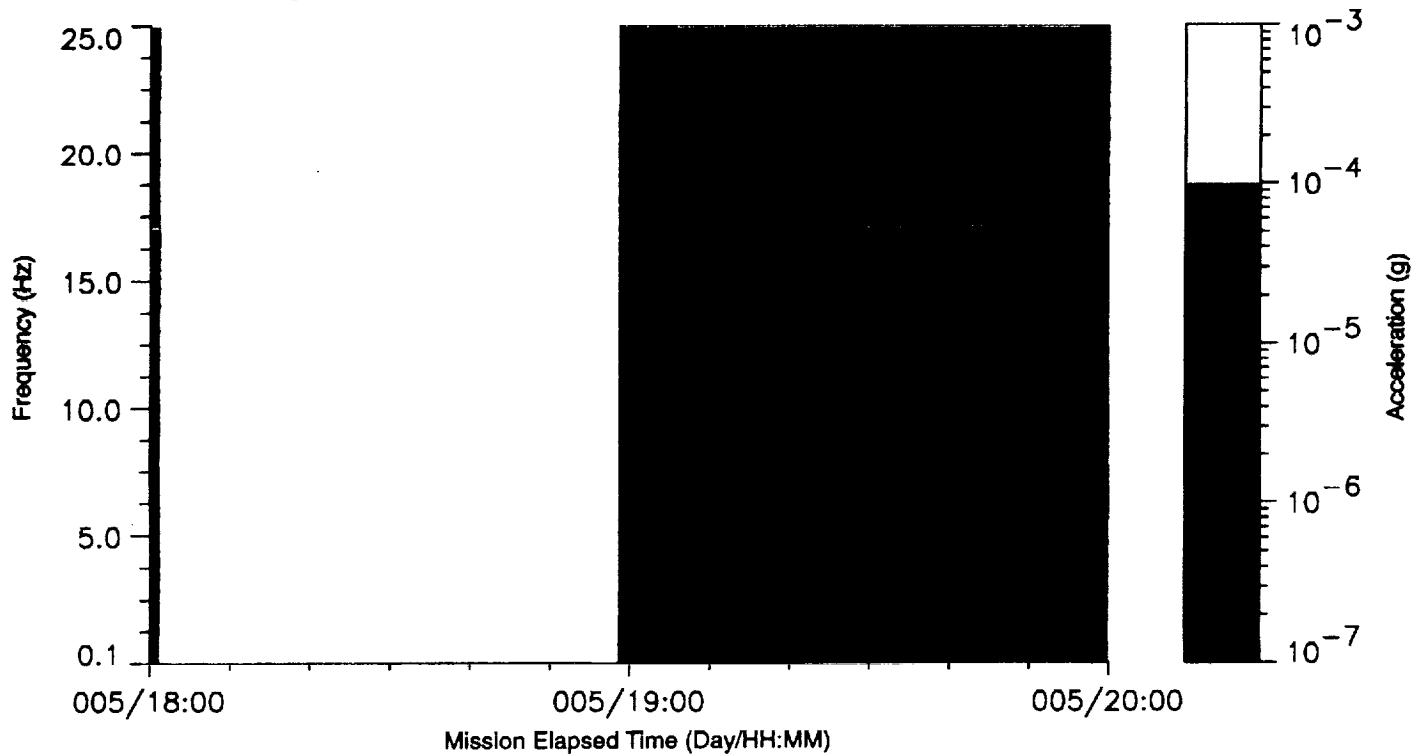
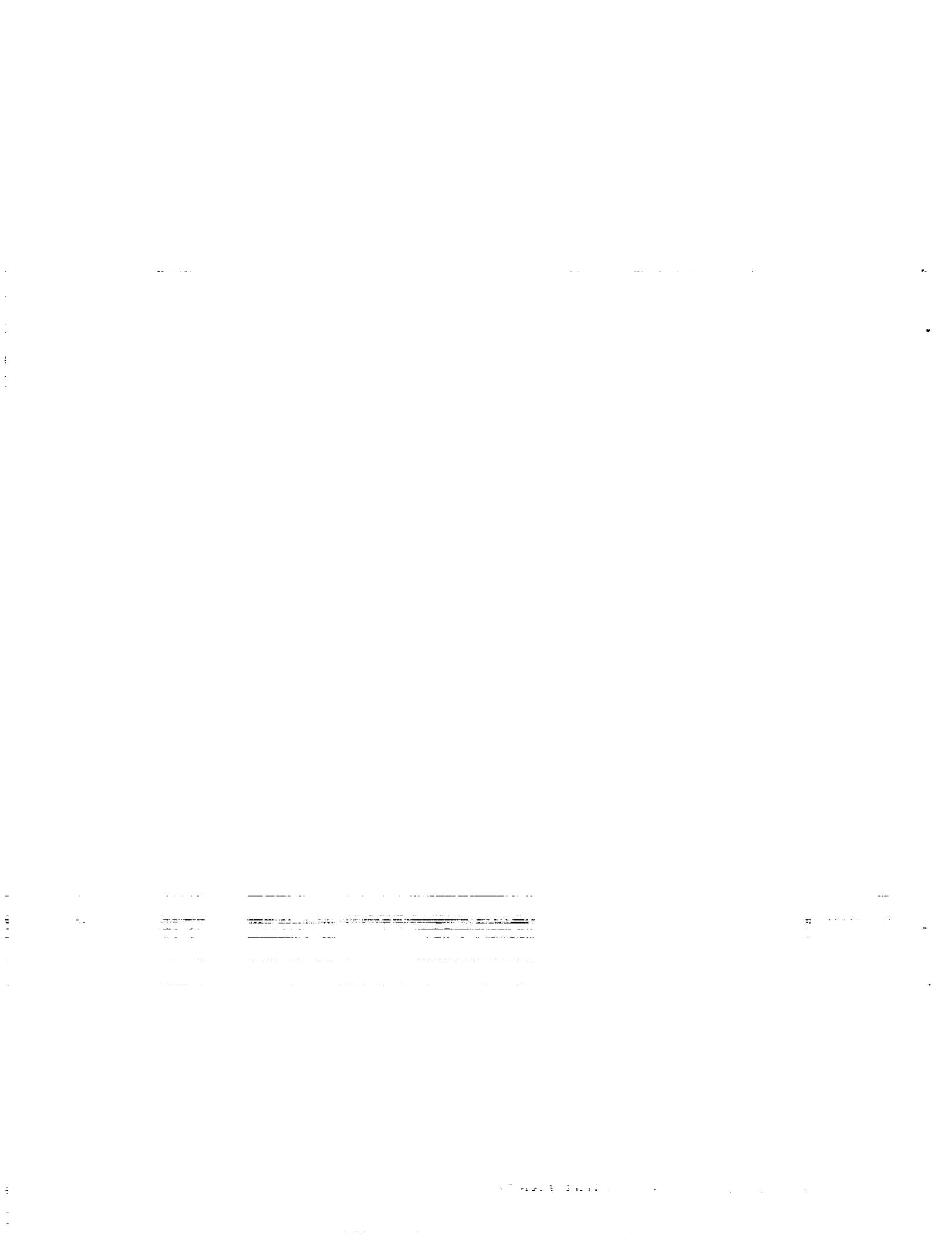


Figure C-47 USMP-2 Port Side of Orbiter Center Line, Vector Magnitude





SUMMARY REPORT OF MISSION ACCELERATION MEASUREMENTS FOR STS-62

Figure C-48 USMP-2 Port Side of Orbiter Center Line, Vector Magnitude

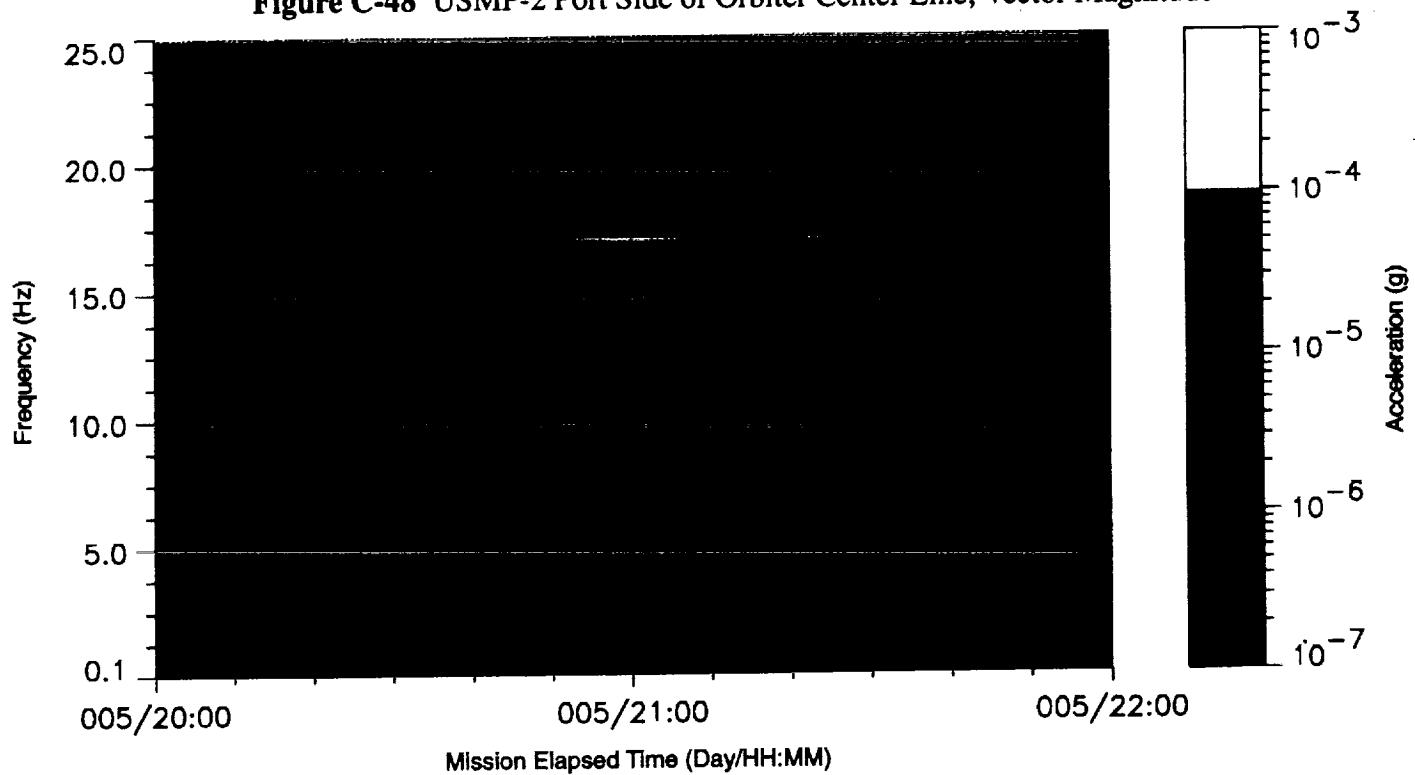
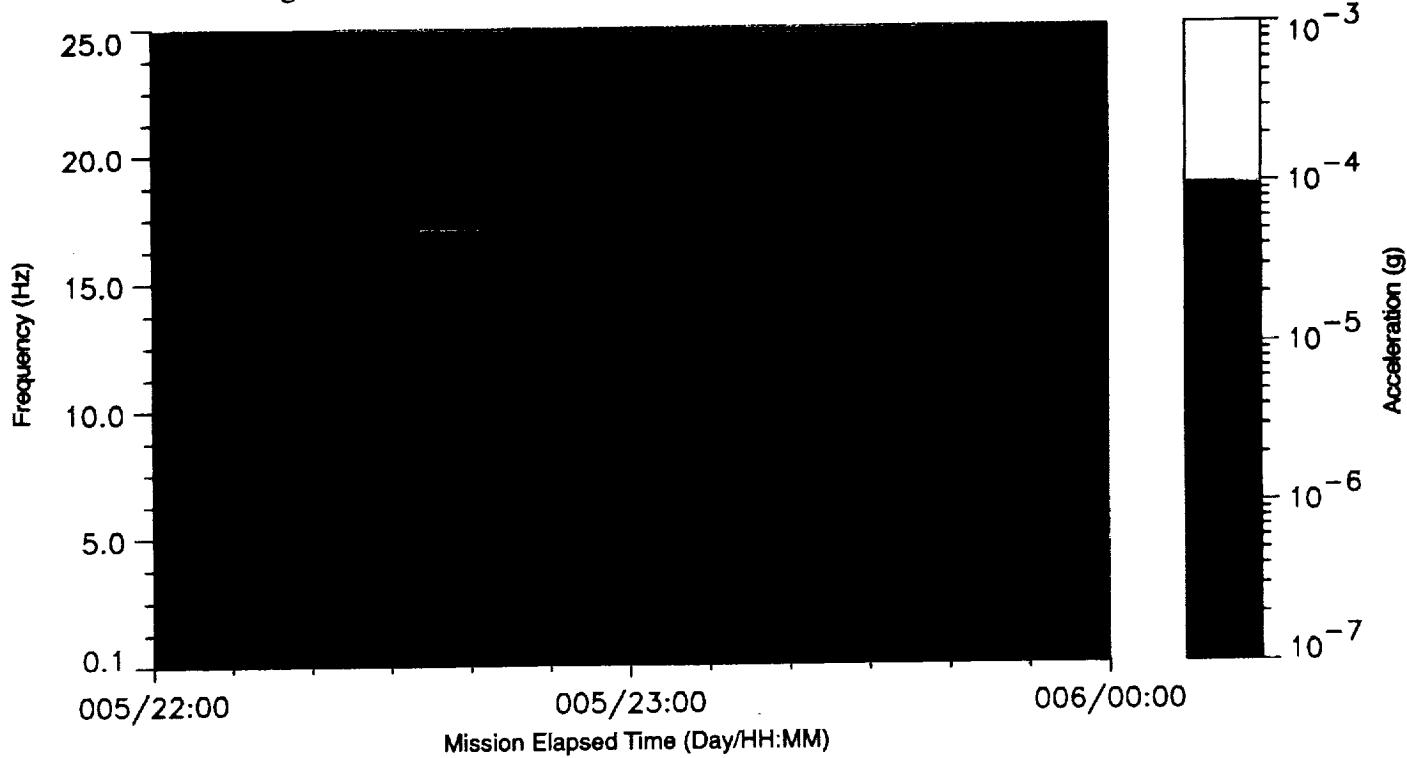


Figure C-49 USMP-2 Port Side of Orbiter Center Line, Vector Magnitude



SUMMARY REPORT OF MISSION ACCELERATION MEASUREMENTS FOR STS-62

Figure C-50 USMP-2 Port Side of Orbiter Center Line, Vector Magnitude

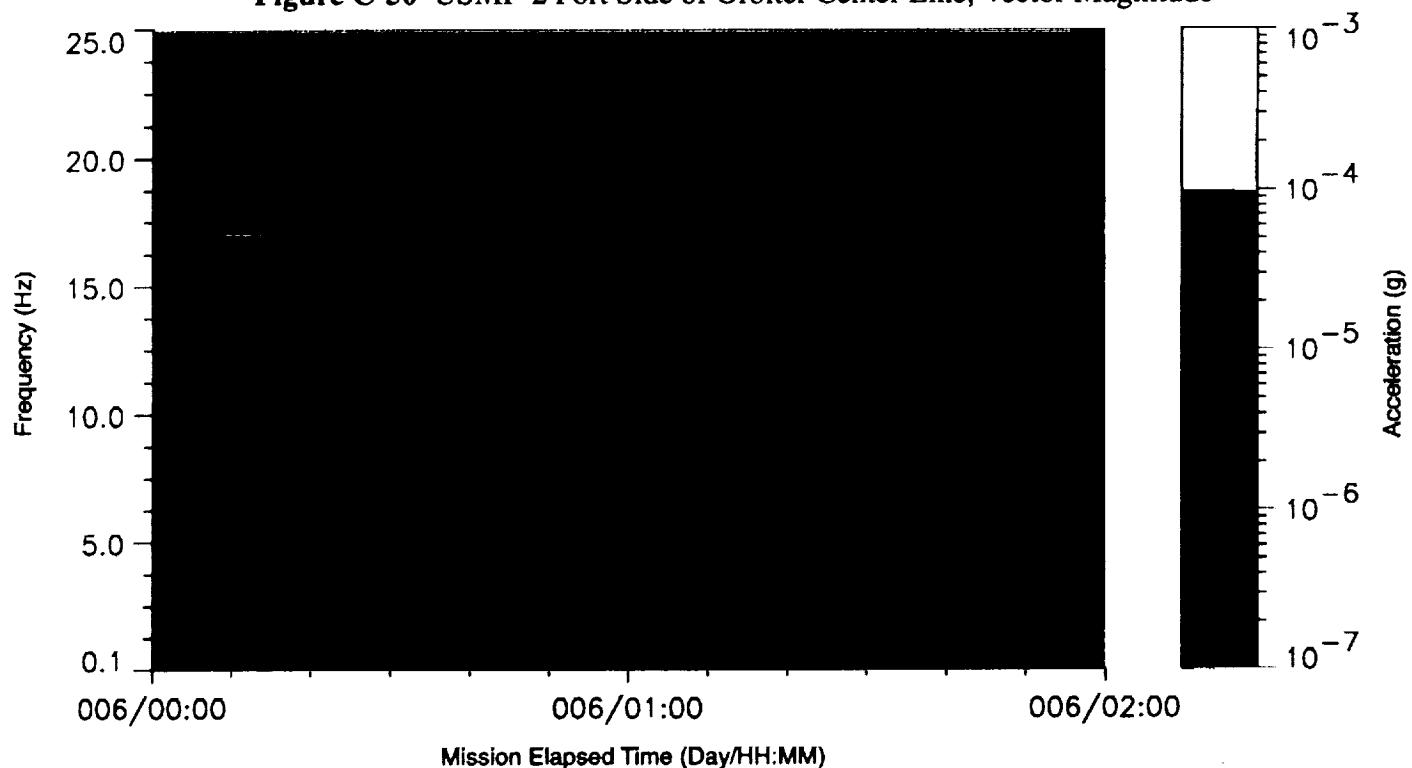
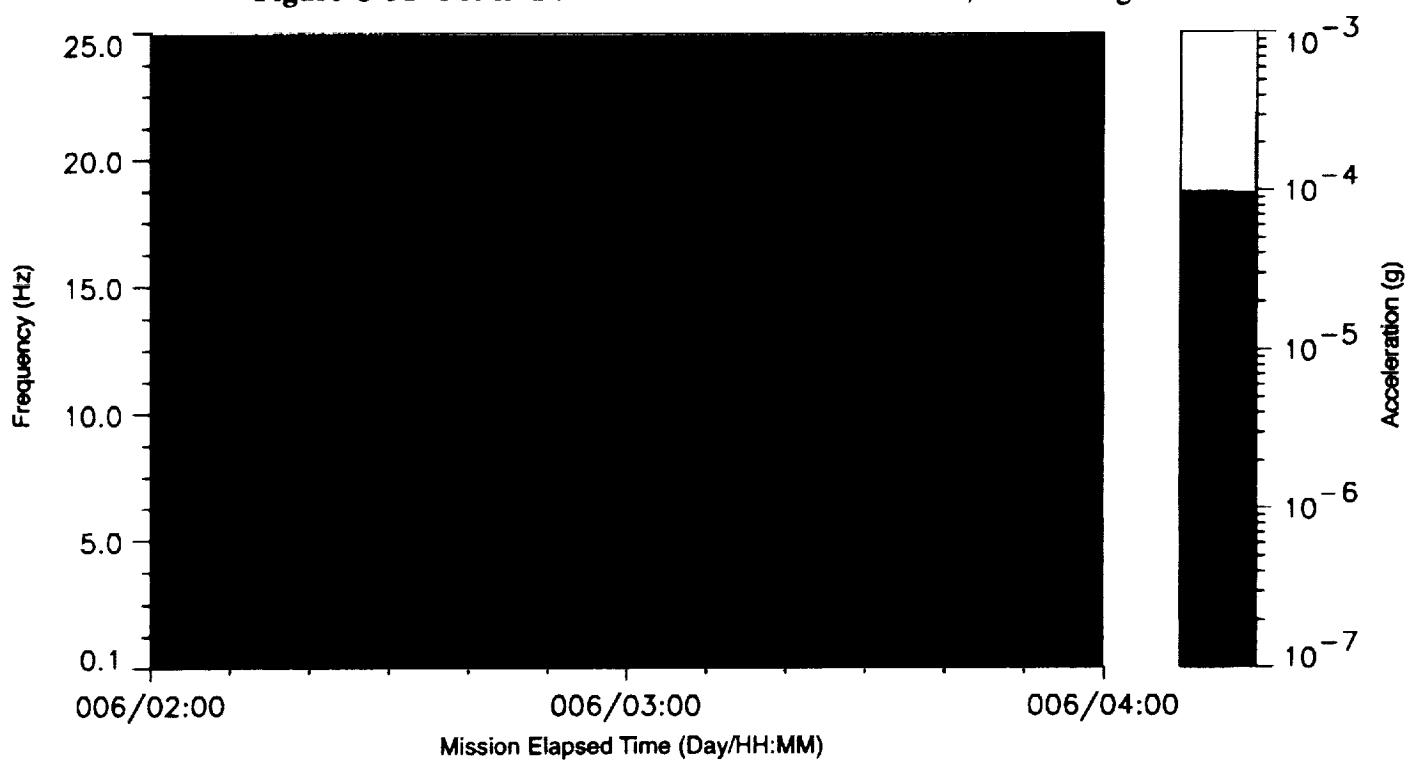
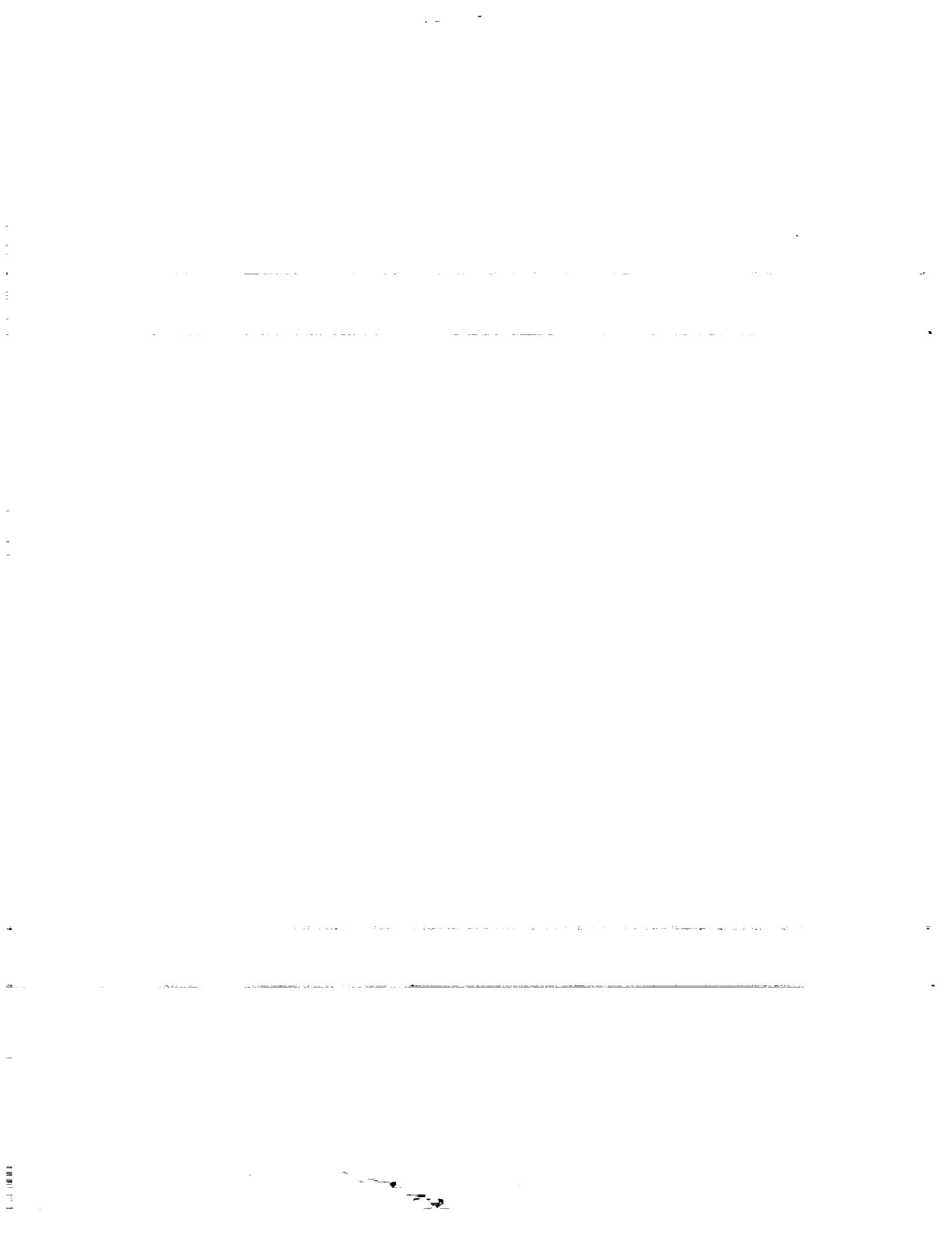


Figure C-51 USMP-2 Port Side of Orbiter Center Line, Vector Magnitude





SUMMARY REPORT OF MISSION ACCELERATION MEASUREMENTS FOR STS-62

Figure C-50 USMP-2 Port Side of Orbiter Center Line, Vector Magnitude

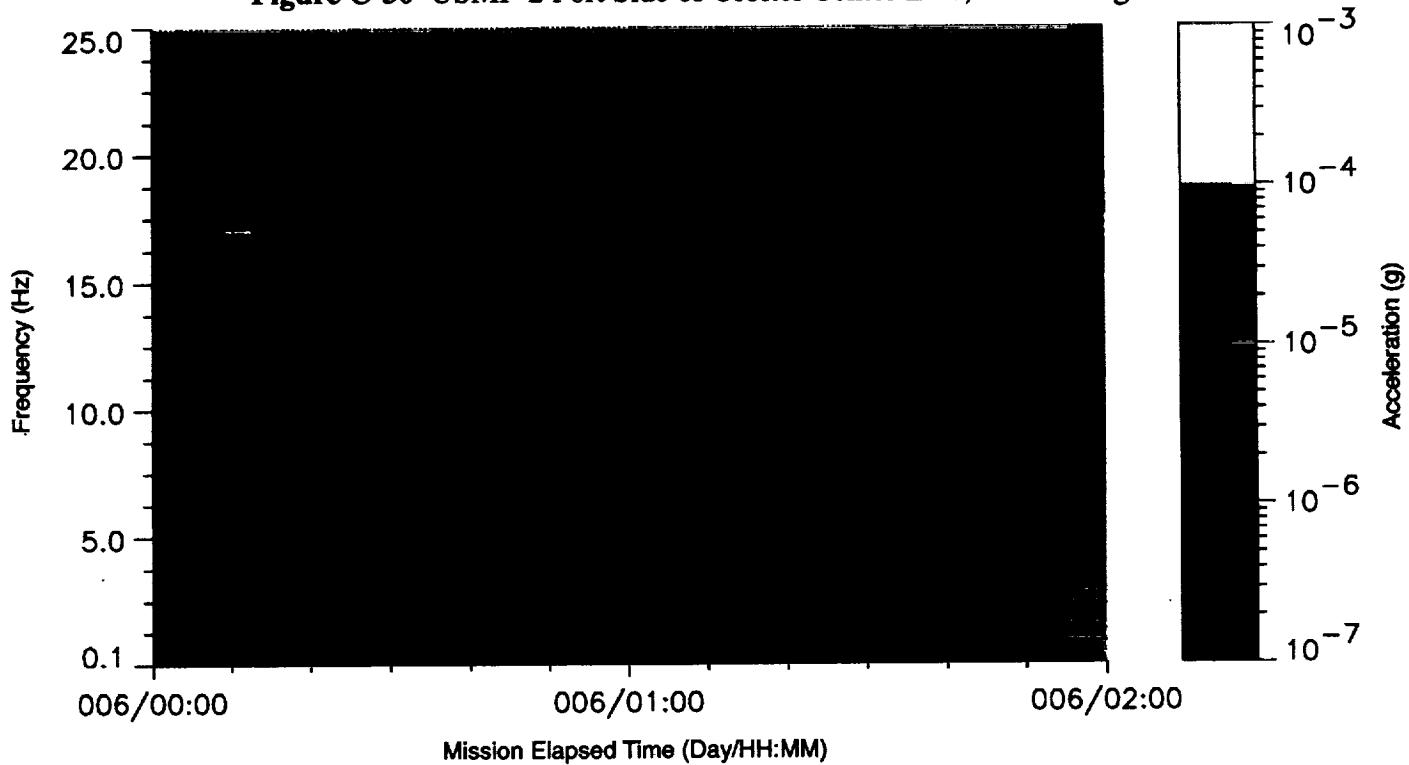
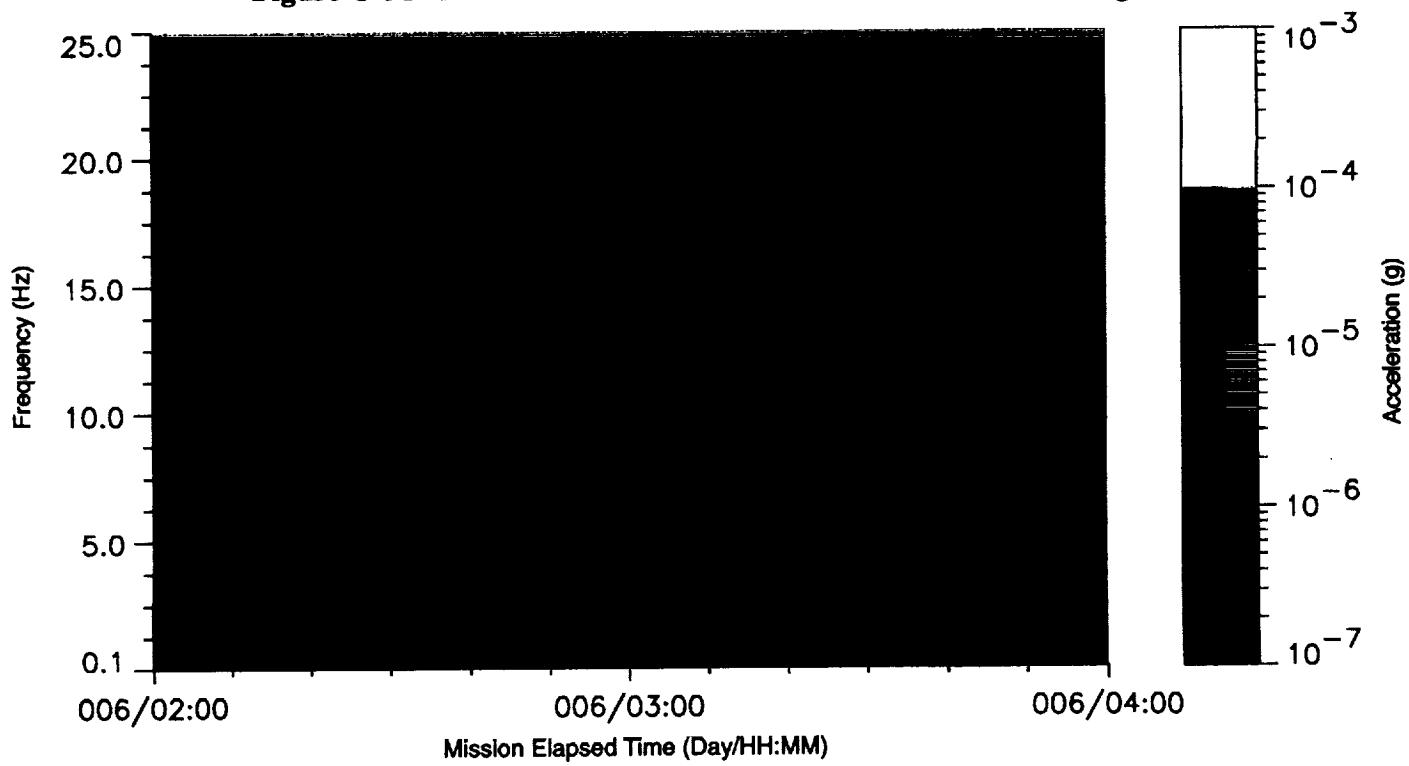


Figure C-51 USMP-2 Port Side of Orbiter Center Line, Vector Magnitude





SUMMARY REPORT OF MISSION ACCELERATION MEASUREMENTS FOR STS-62

Figure C-52 USMP-2 Port Side of Orbiter Center Line, Vector Magnitude

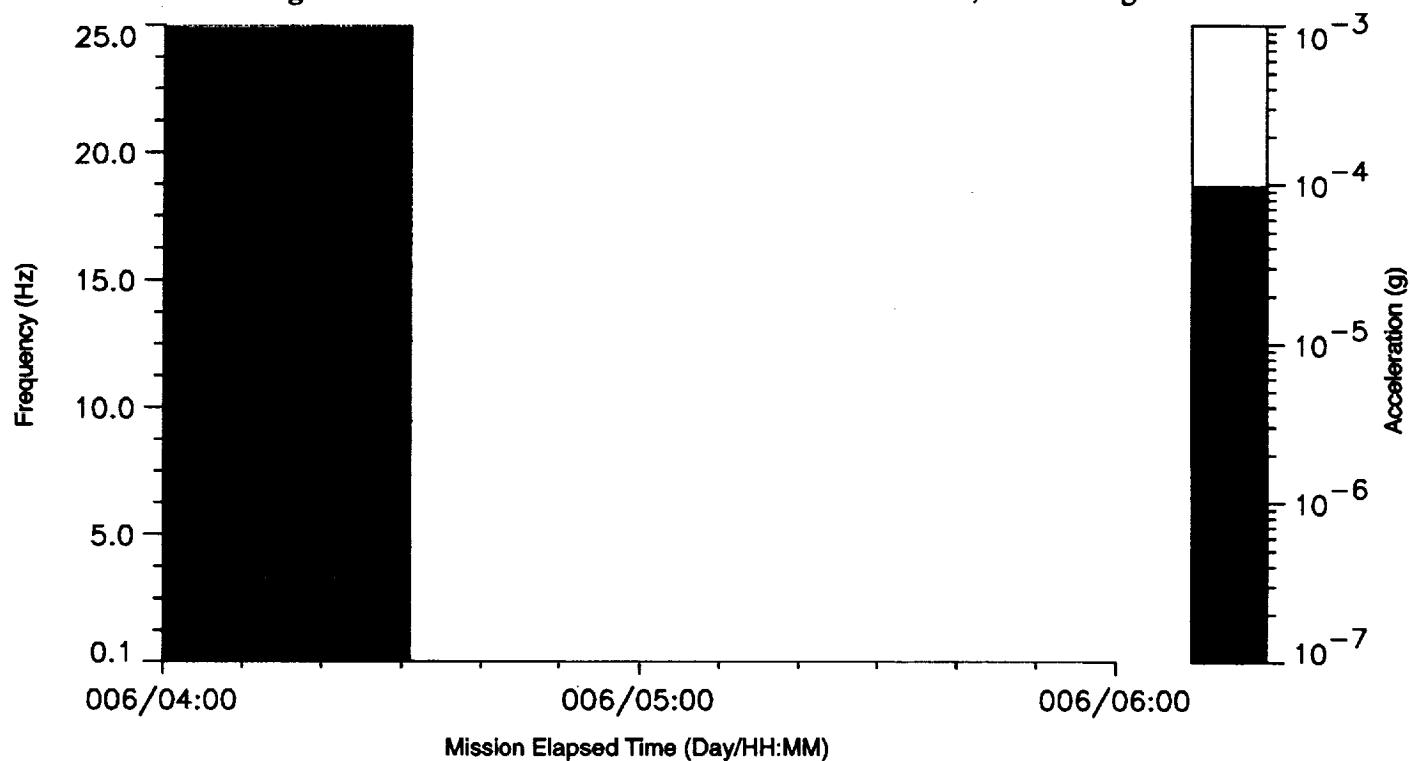
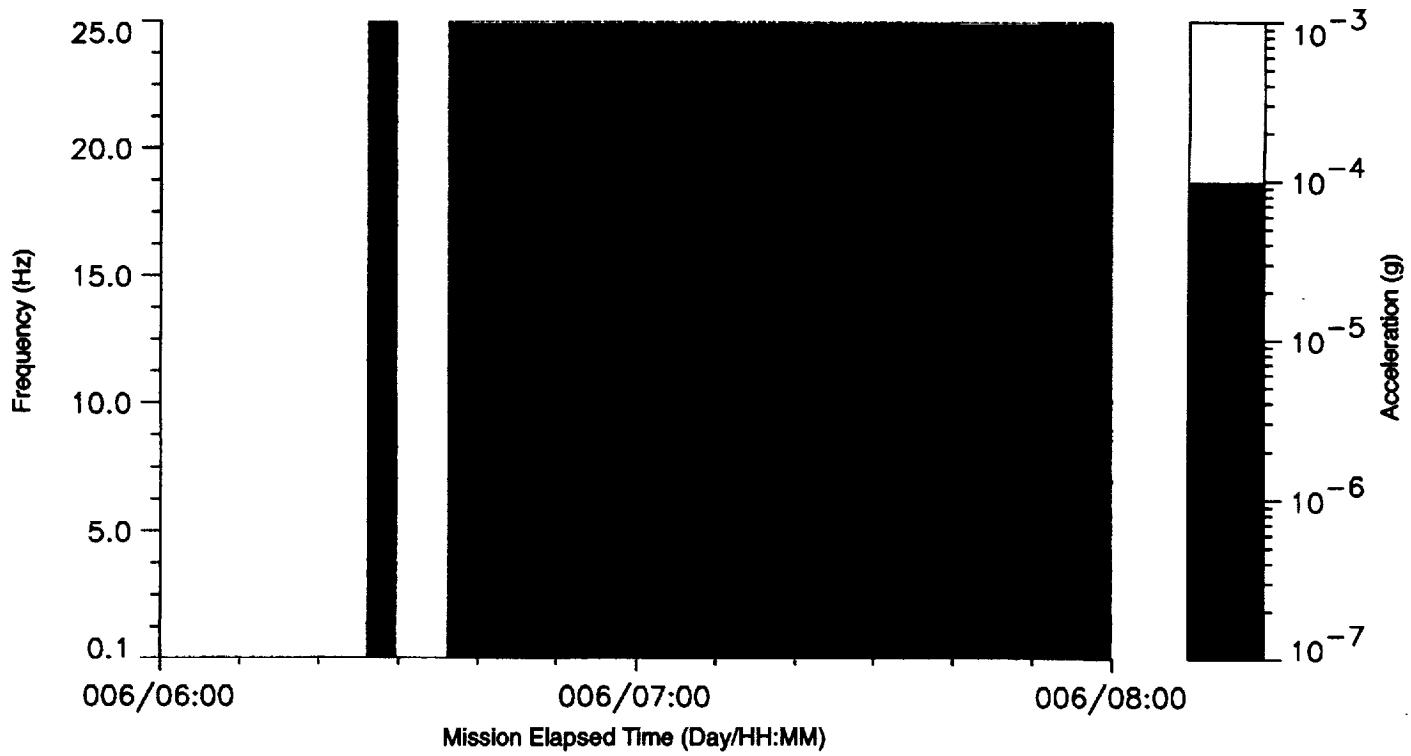
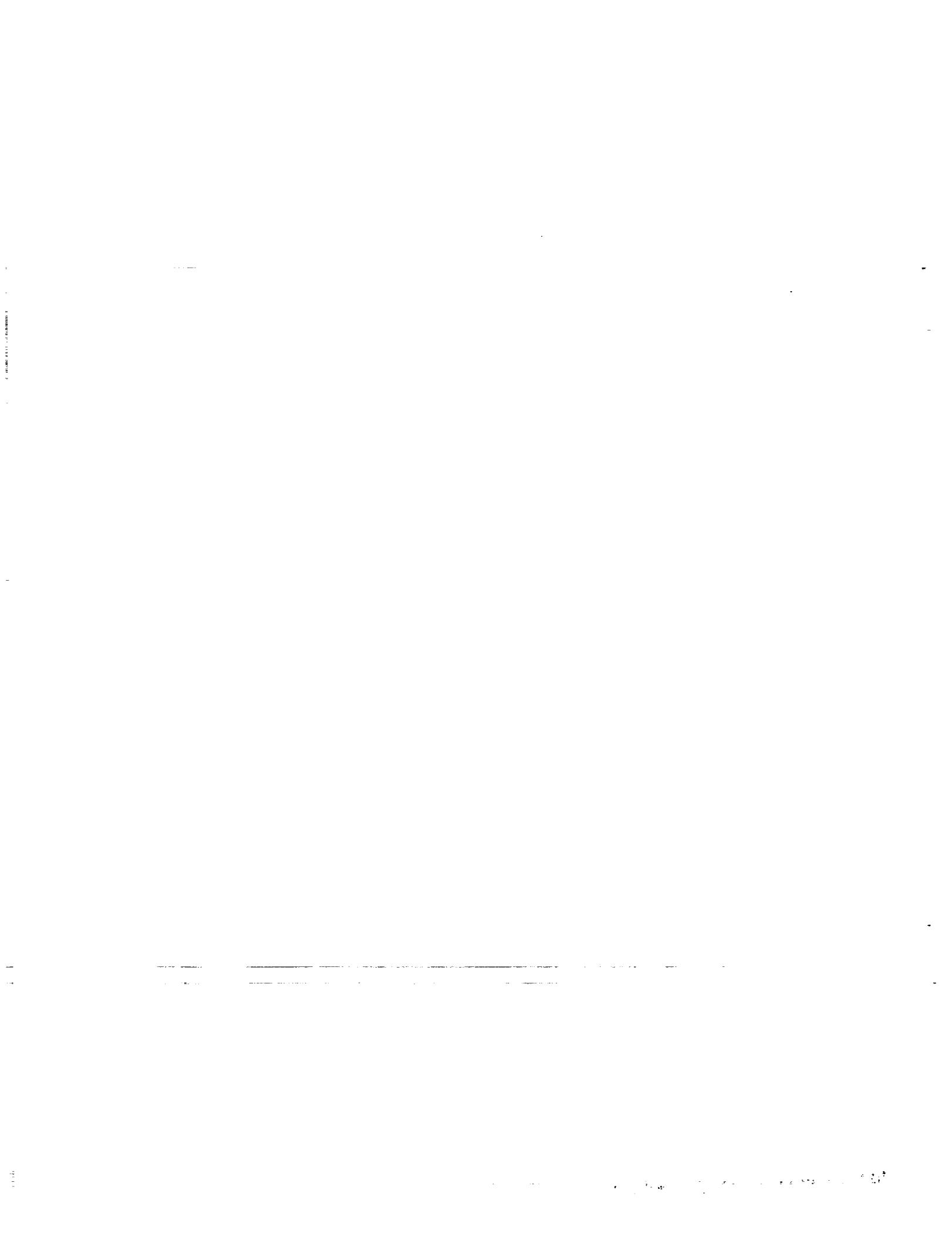


Figure C-53 USMP-2 Port Side of Orbiter Center Line, Vector Magnitude





SUMMARY REPORT OF MISSION ACCELERATION MEASUREMENTS FOR STS-62

Figure C-54 USMP-2 Port Side of Orbiter Center Line, Vector Magnitude

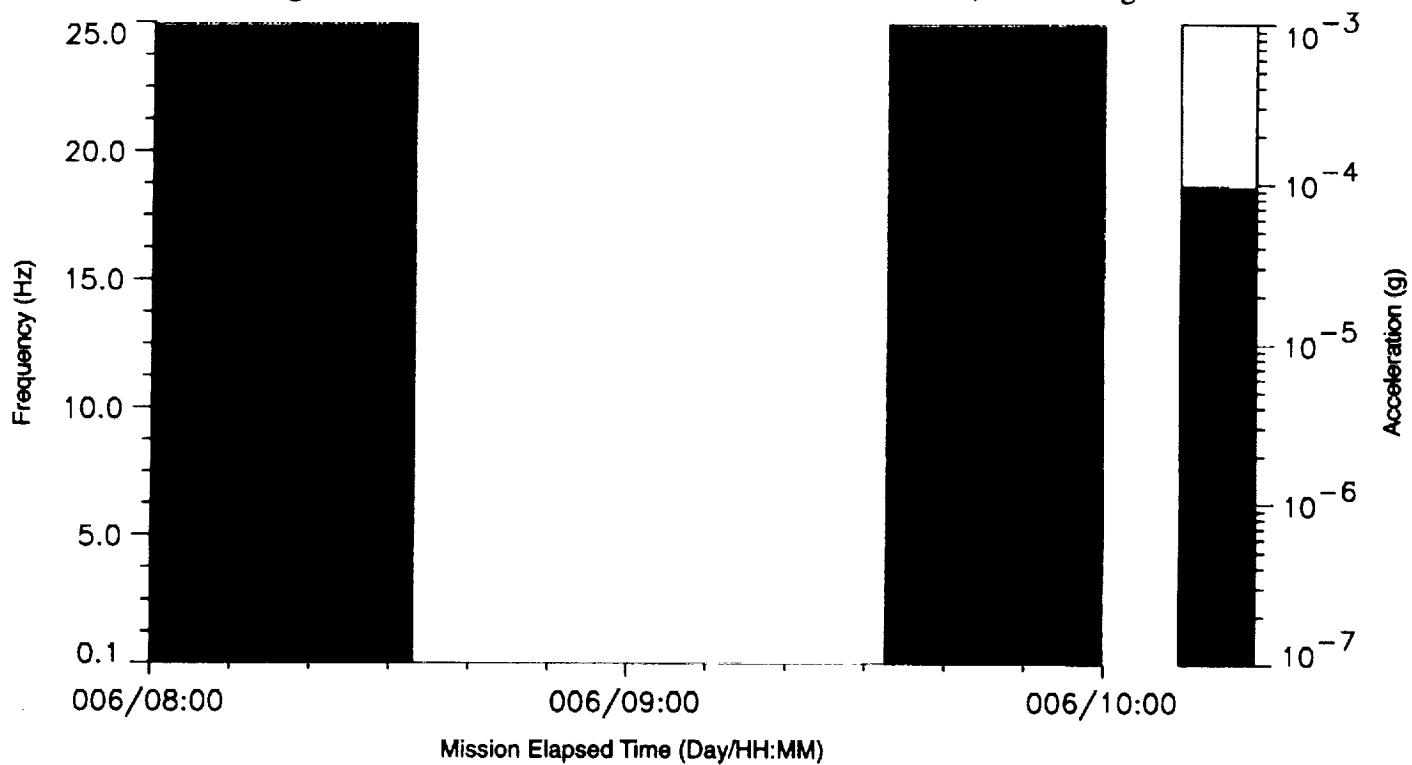
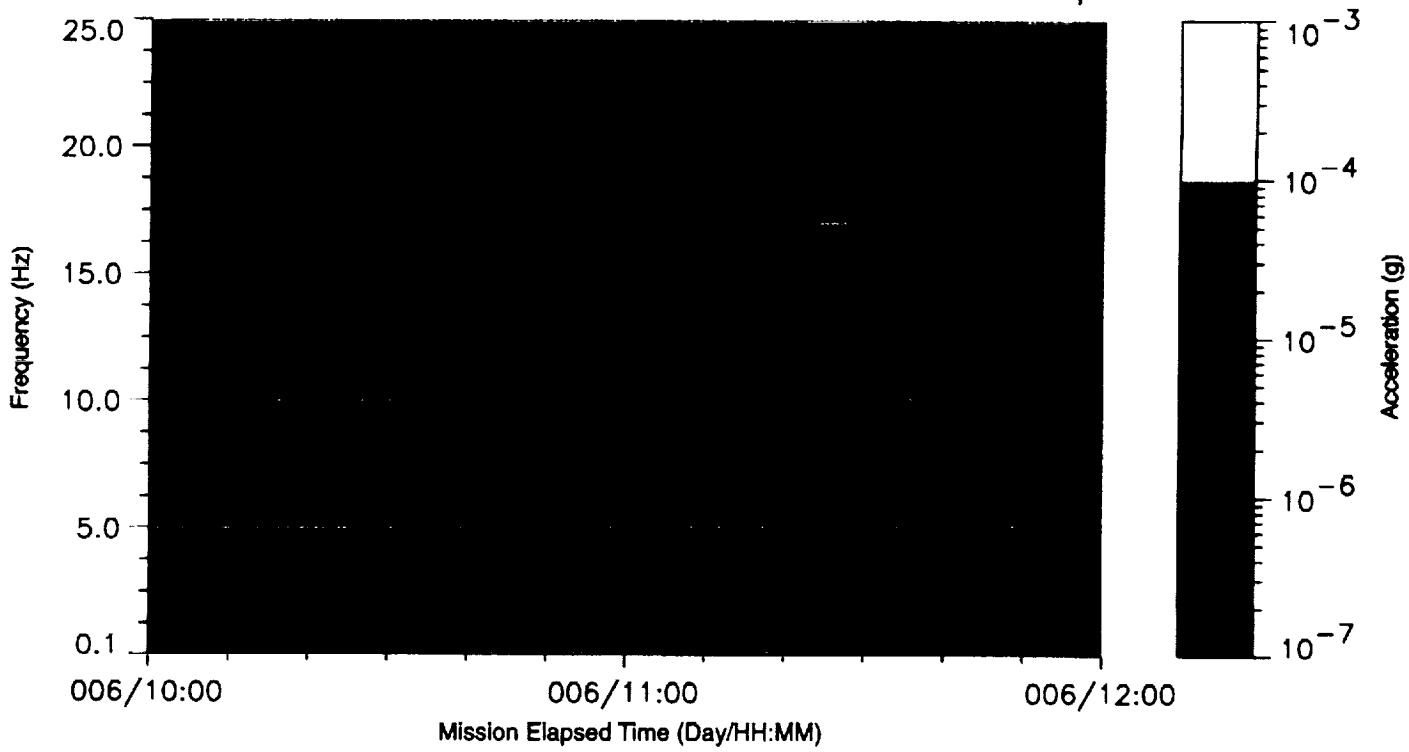
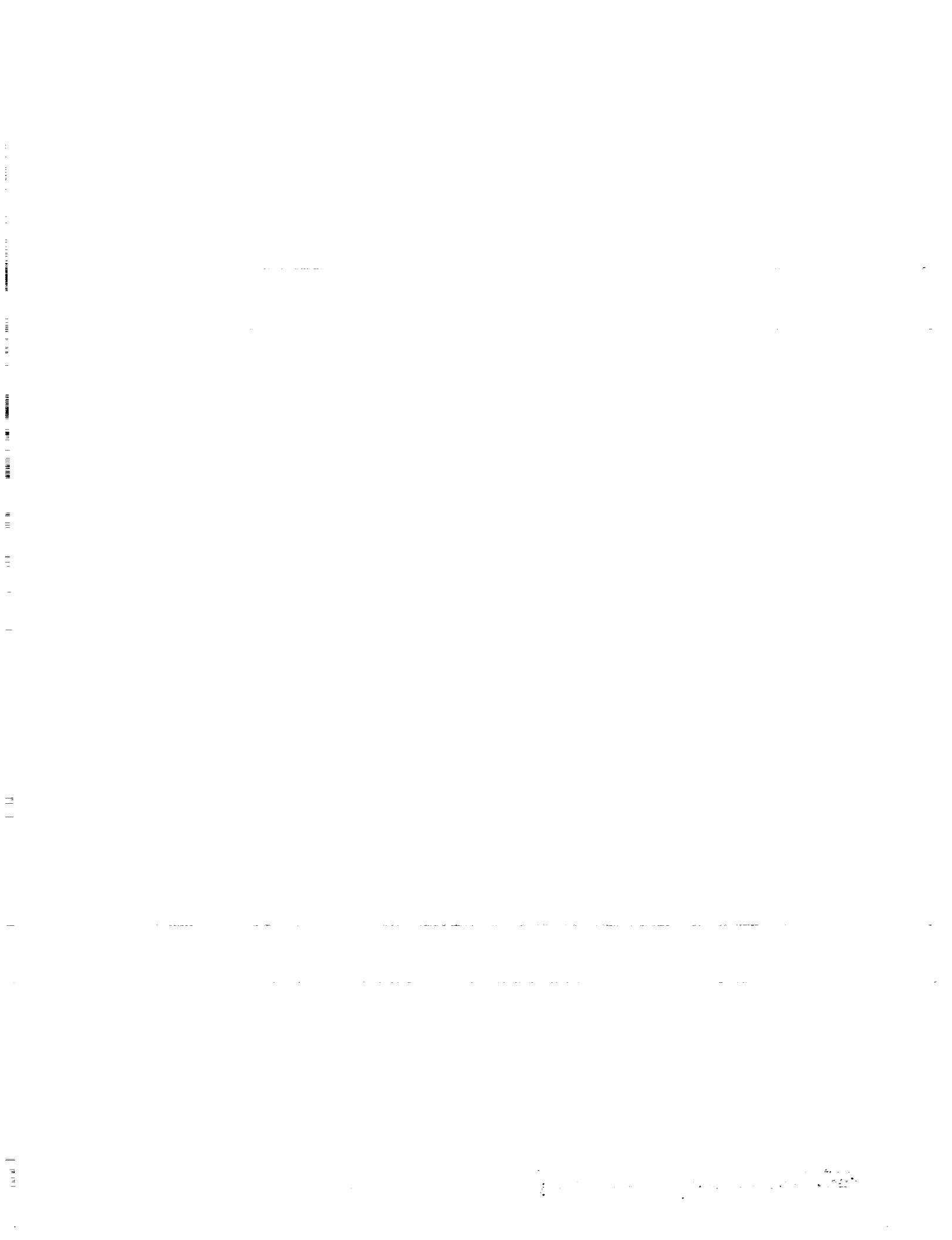


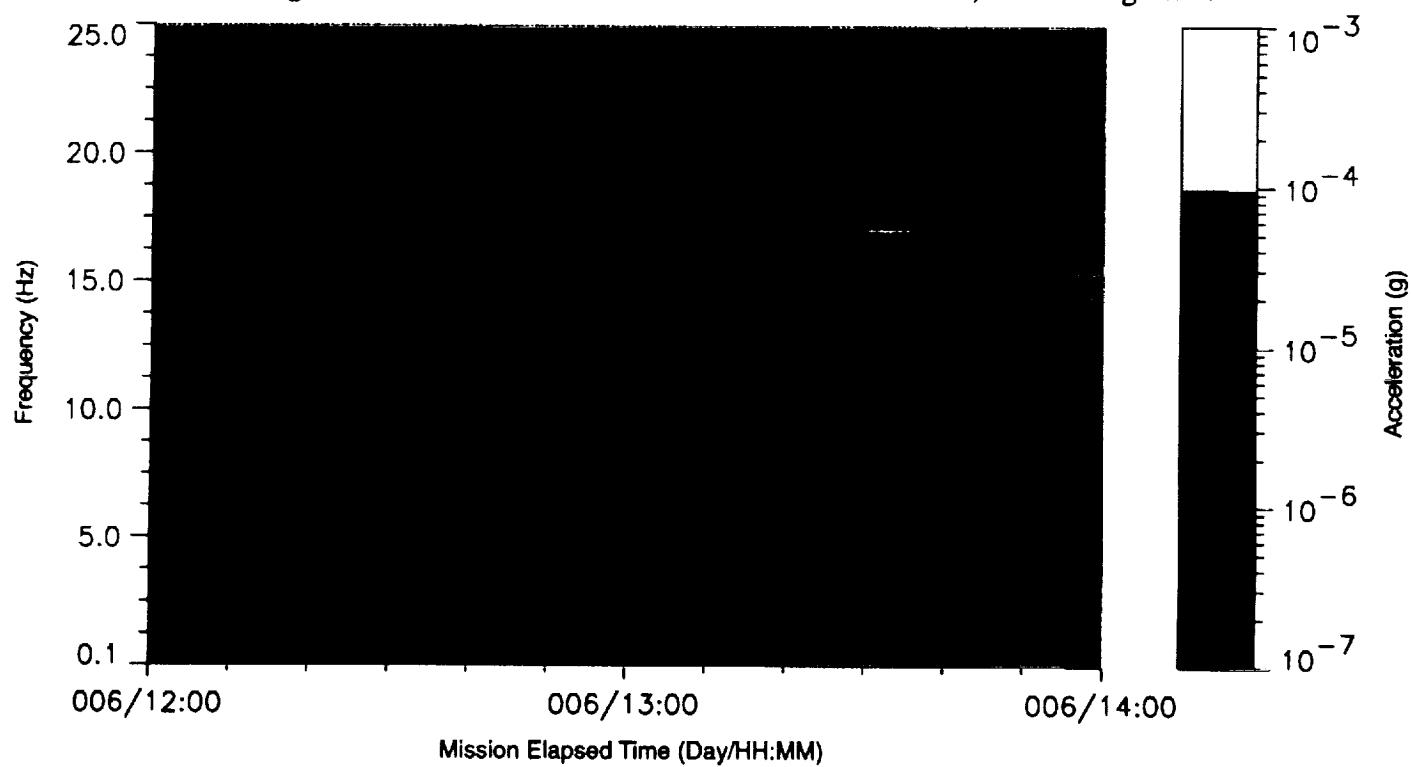
Figure C-55 USMP-2 Port Side of Orbiter Center Line, Vector Magnitude





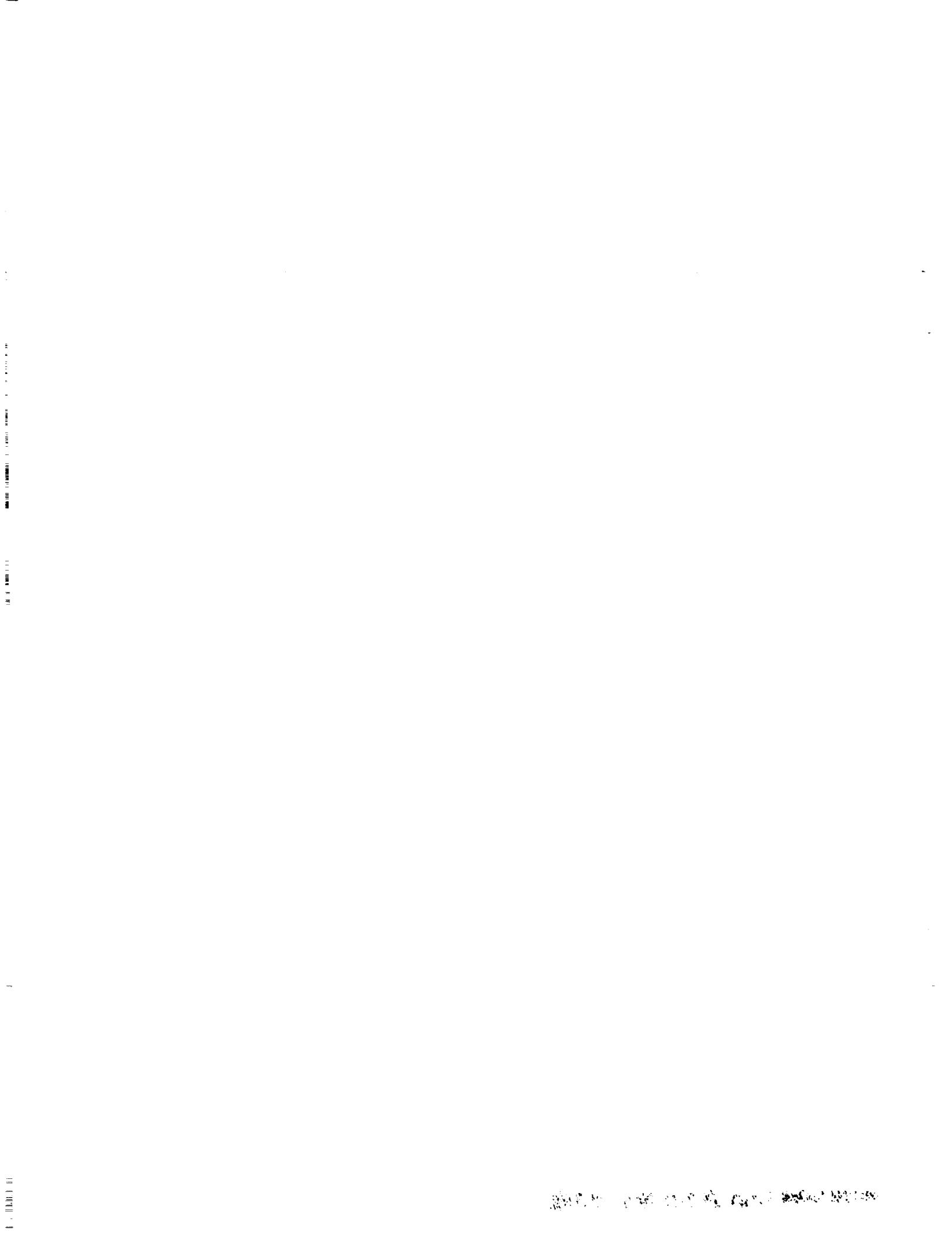
SUMMARY REPORT OF MISSION ACCELERATION MEASUREMENTS FOR STS-62

Figure C-56 USMP-2 Port Side of Orbiter Center Line, Vector Magnitude



NO DATA AVAILABLE FOR USMP-2, UNIT F, HEAD B

FROM MET 006/14:00:00 - 006/17:38:00



SUMMARY REPORT OF MISSION ACCELERATION MEASUREMENTS FOR STS-62

Figure C-57 USMP-2 Port Side of Orbiter Center Line, Vector Magnitude

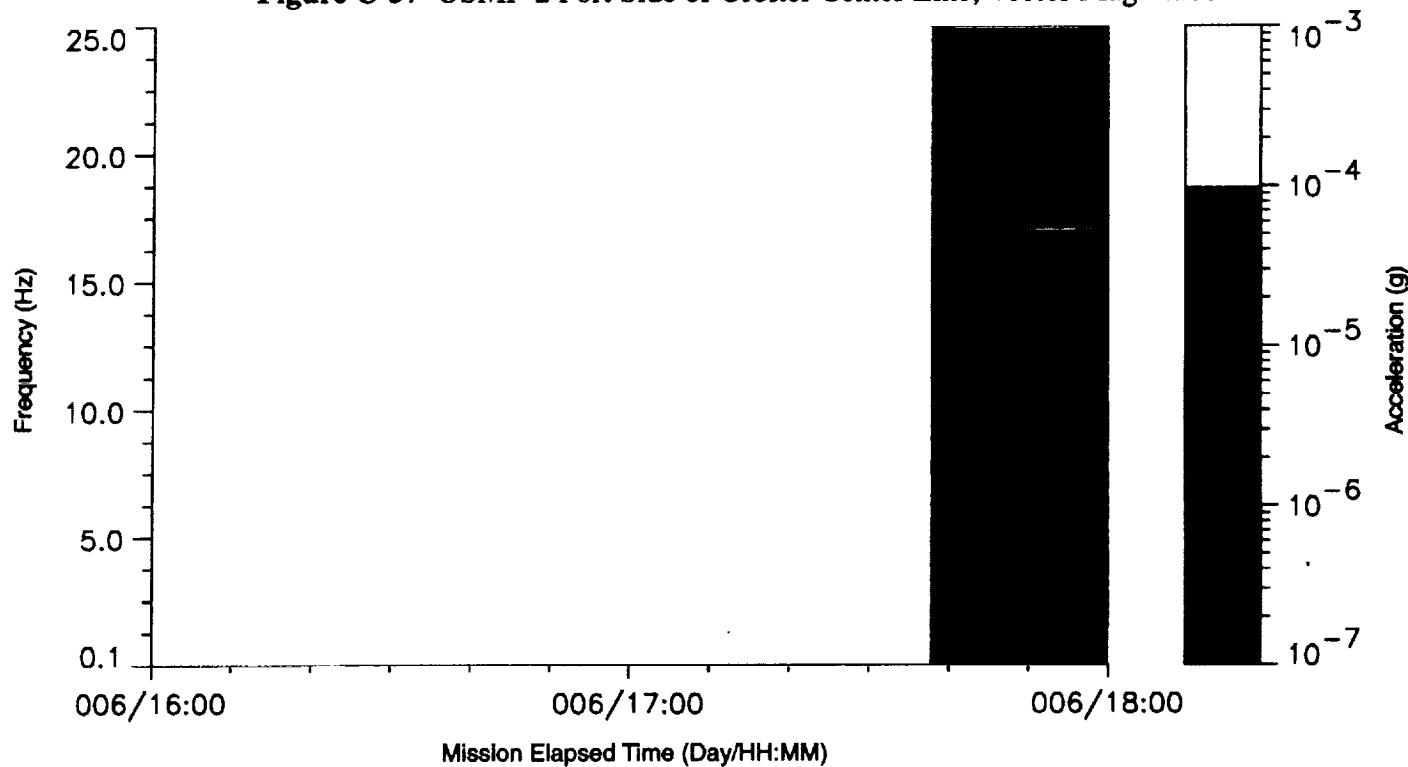
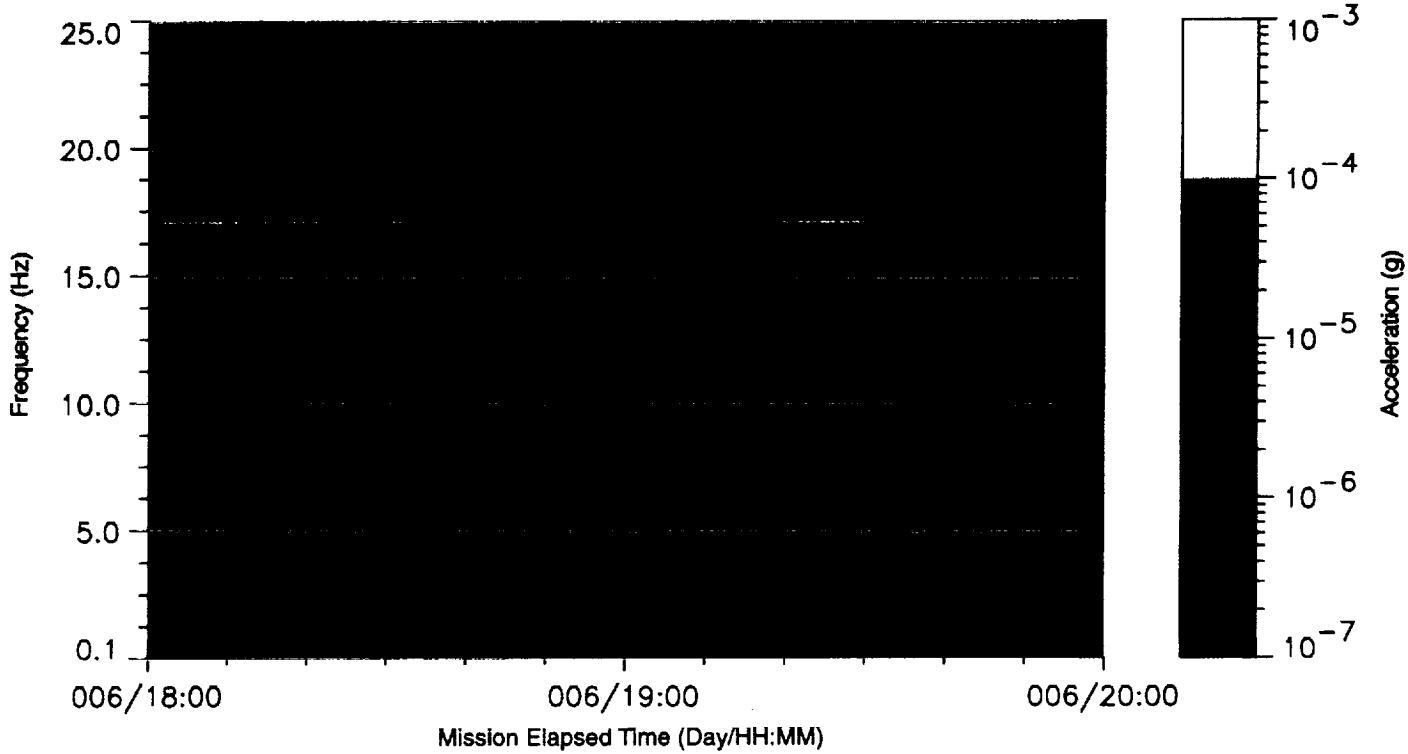


Figure C-58 USMP-2 Port Side of Orbiter Center Line, Vector Magnitude



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SUMMARY REPORT OF MISSION ACCELERATION MEASUREMENTS FOR STS-62

Figure C-40 USMP-2 Port Side of Orbiter Center Line, Vector Magnitude

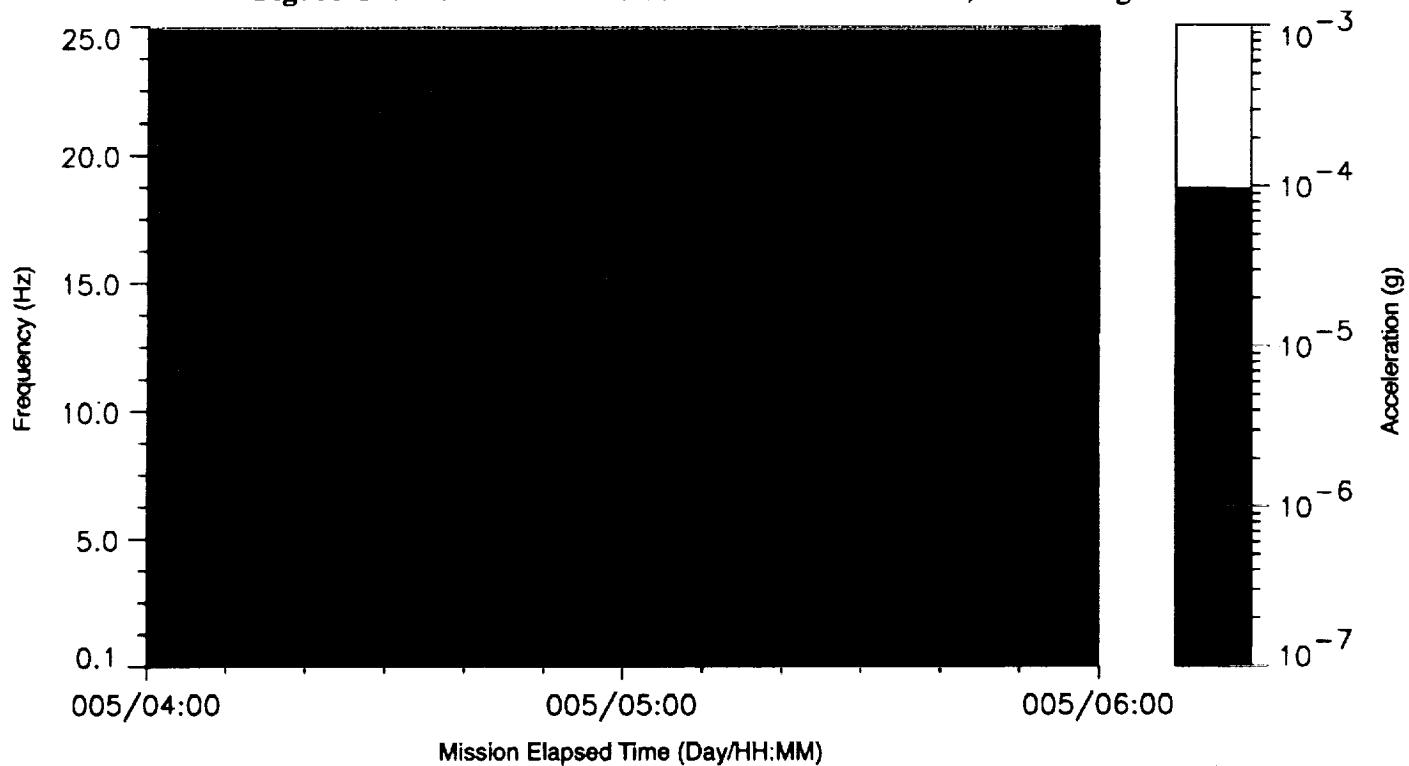
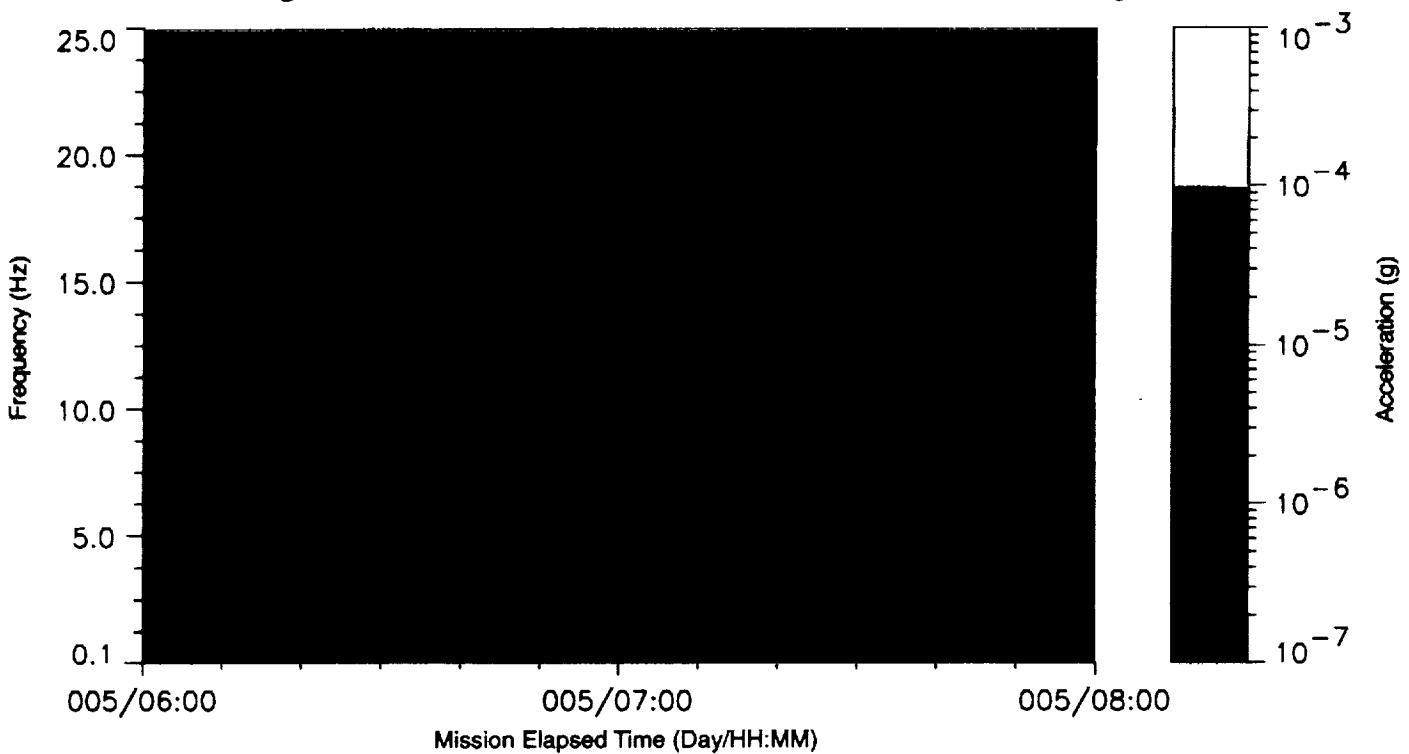
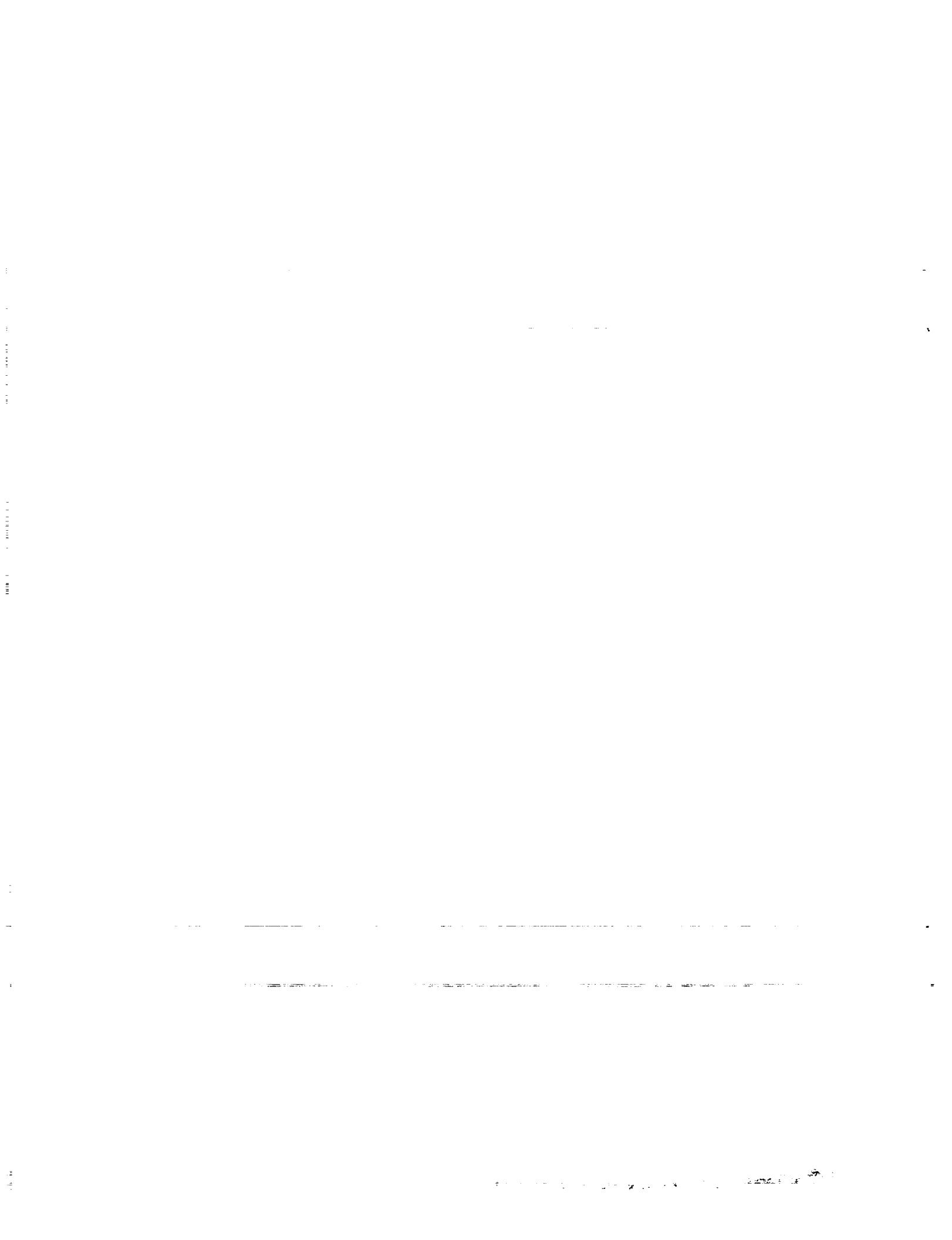


Figure C-41 USMP-2 Port Side of Orbiter Center Line, Vector Magnitude





SUMMARY REPORT OF MISSION ACCELERATION MEASUREMENTS FOR STS-62

Figure C-59 USMP-2 Port Side of Orbiter Center Line, Vector Magnitude

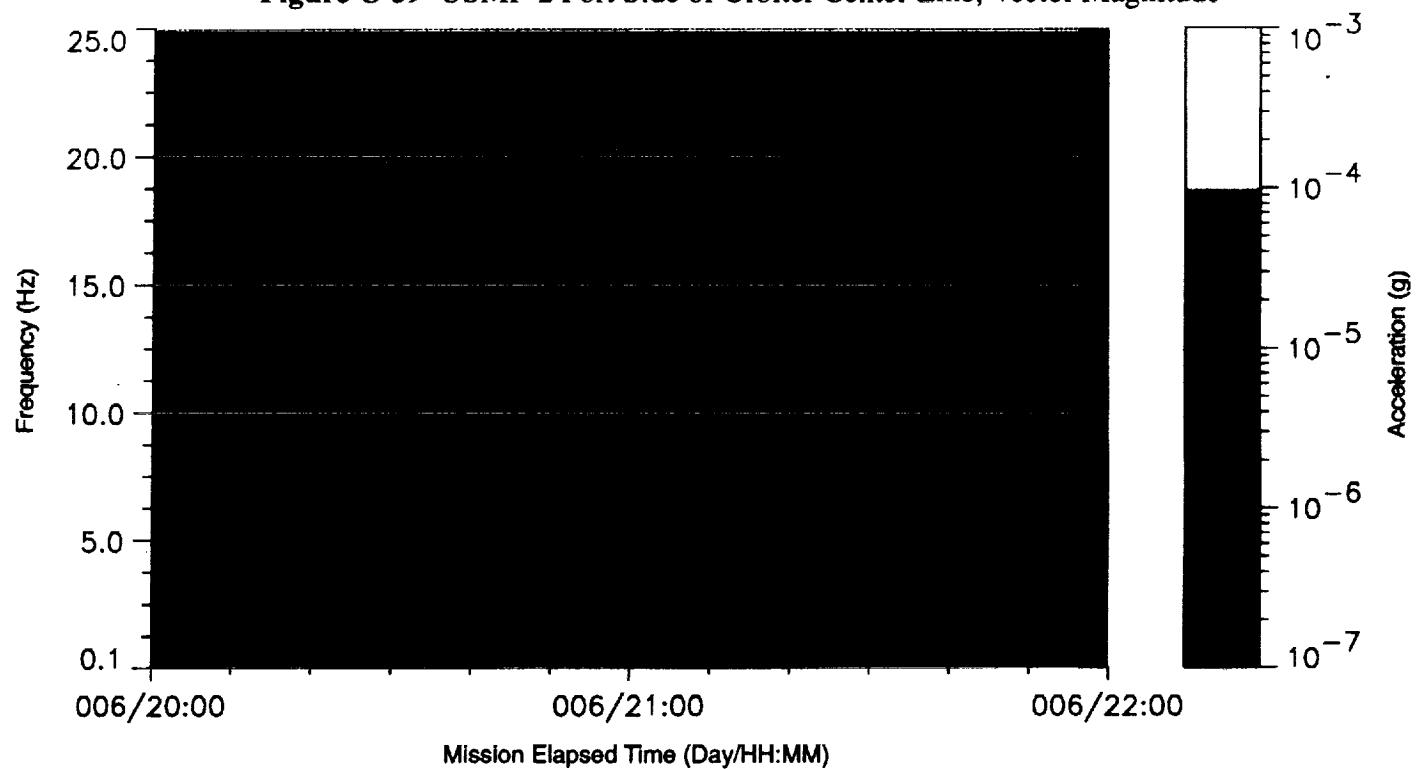
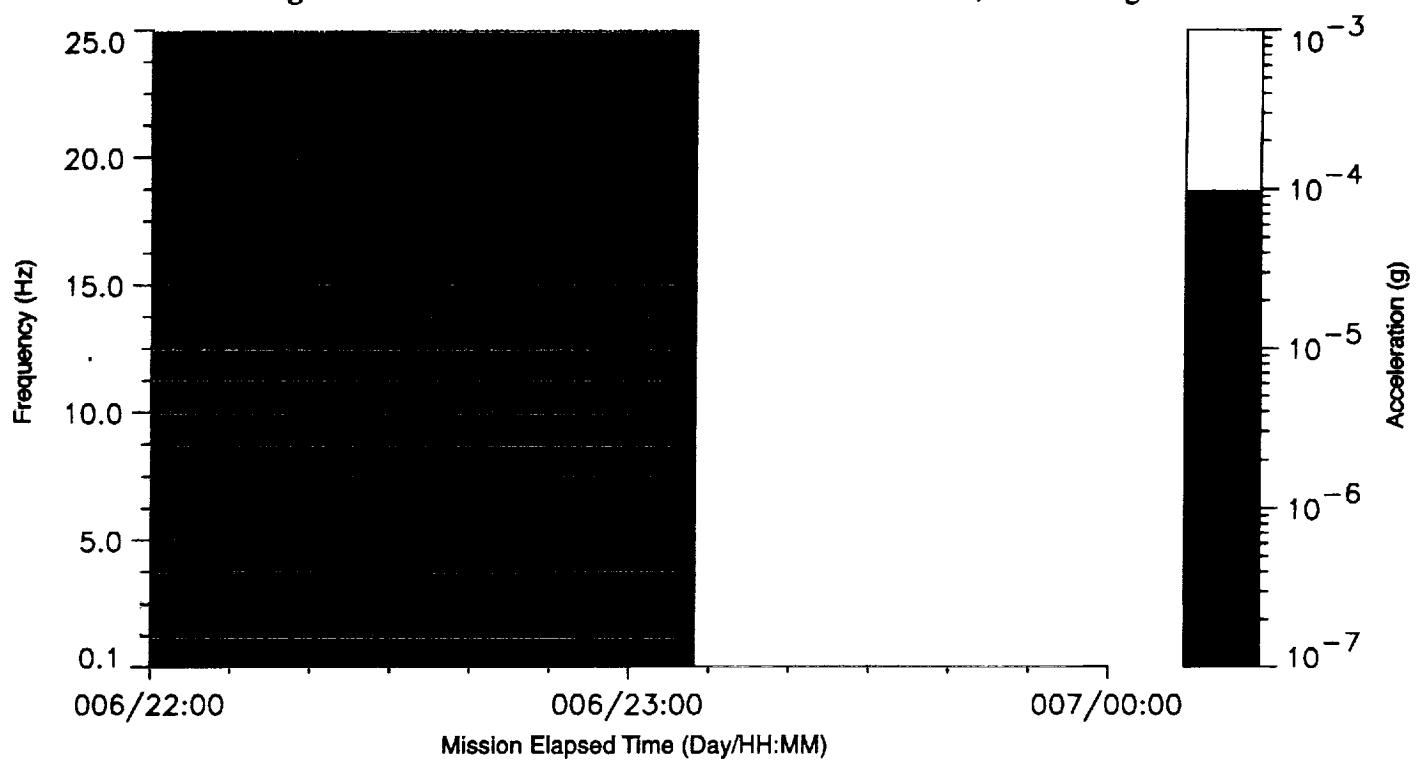
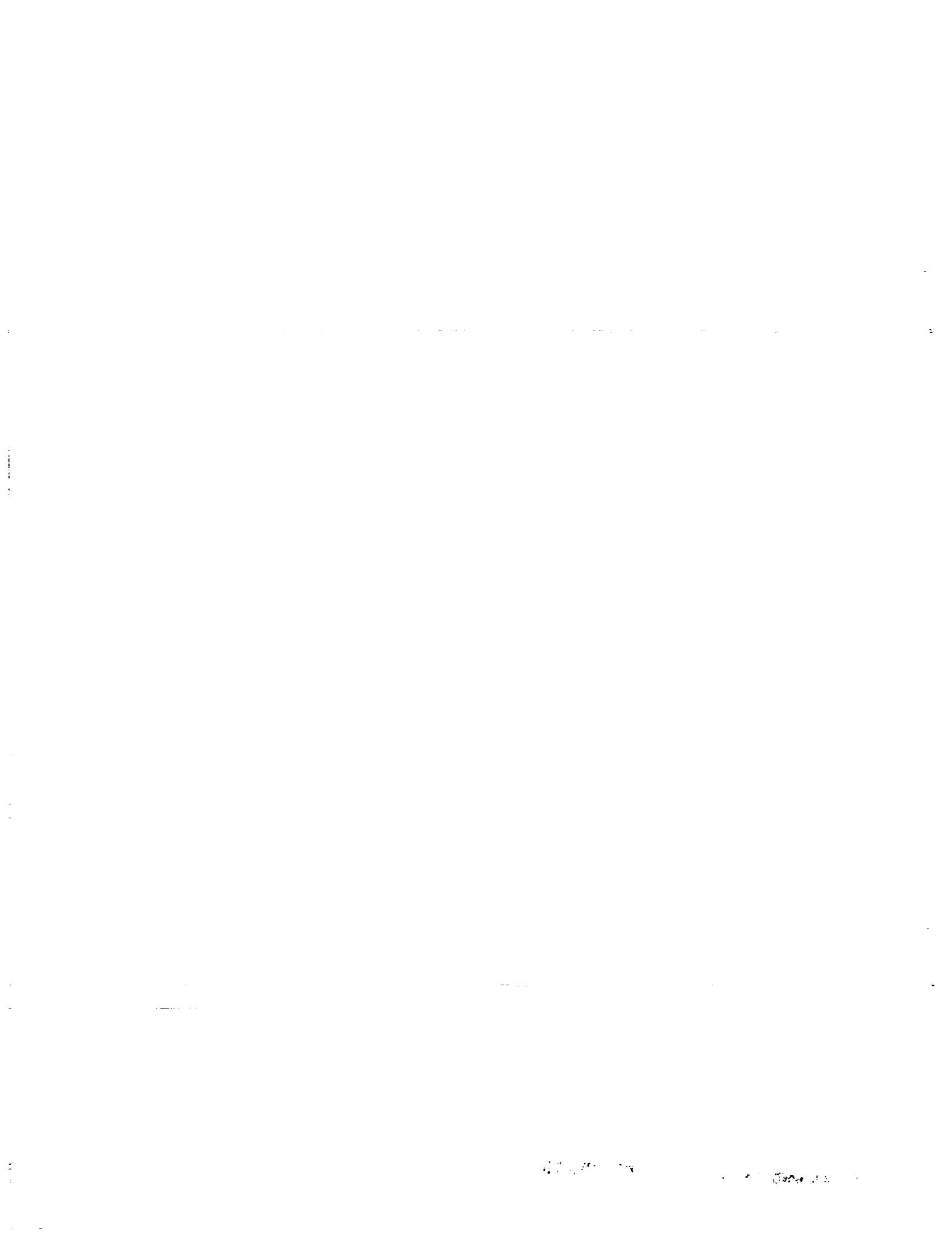


Figure C-60 USMP-2 Port Side of Orbiter Center Line, Vector Magnitude





SUMMARY REPORT OF MISSION ACCELERATION MEASUREMENTS FOR STS-62

NO DATA AVAILABLE FOR USMP-2, UNIT F, HEAD B

FROM MET 006/23:08:00 - 008/06:28:00

1. 2. 3. 4. 5. 6. 7. 8. 9. 10.

SUMMARY REPORT OF MISSION ACCELERATION MEASUREMENTS FOR STS-62

Figure C-61 USMP-2 Port Side of Orbiter Center Line, Vector Magnitude

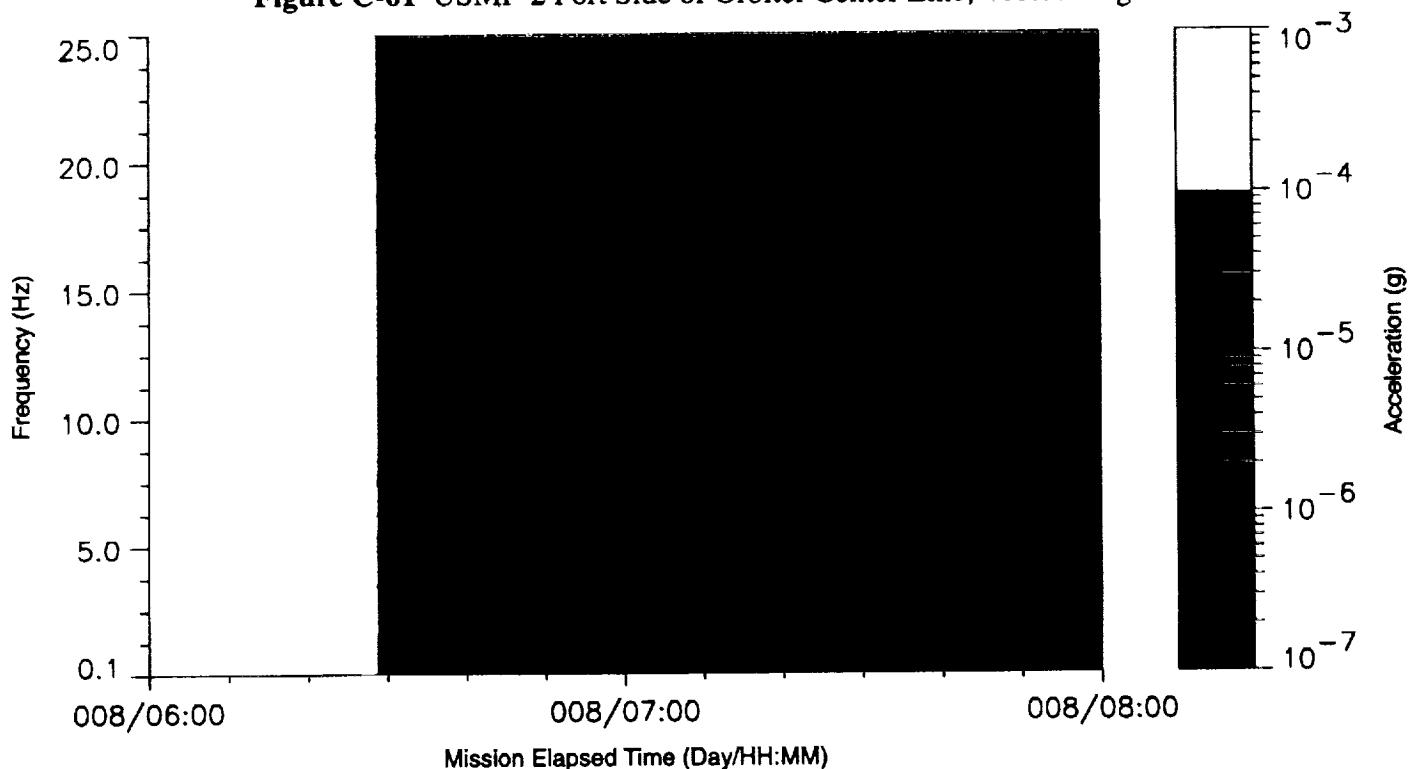
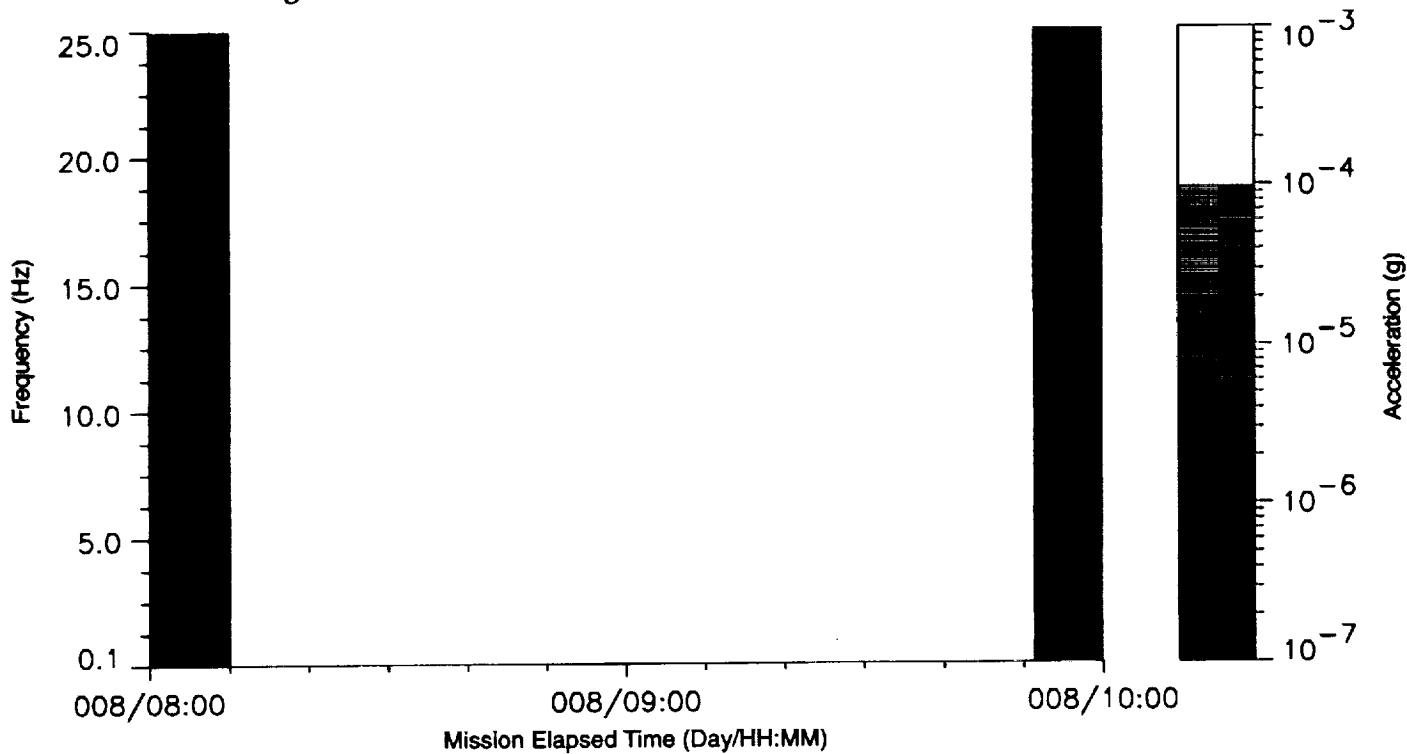
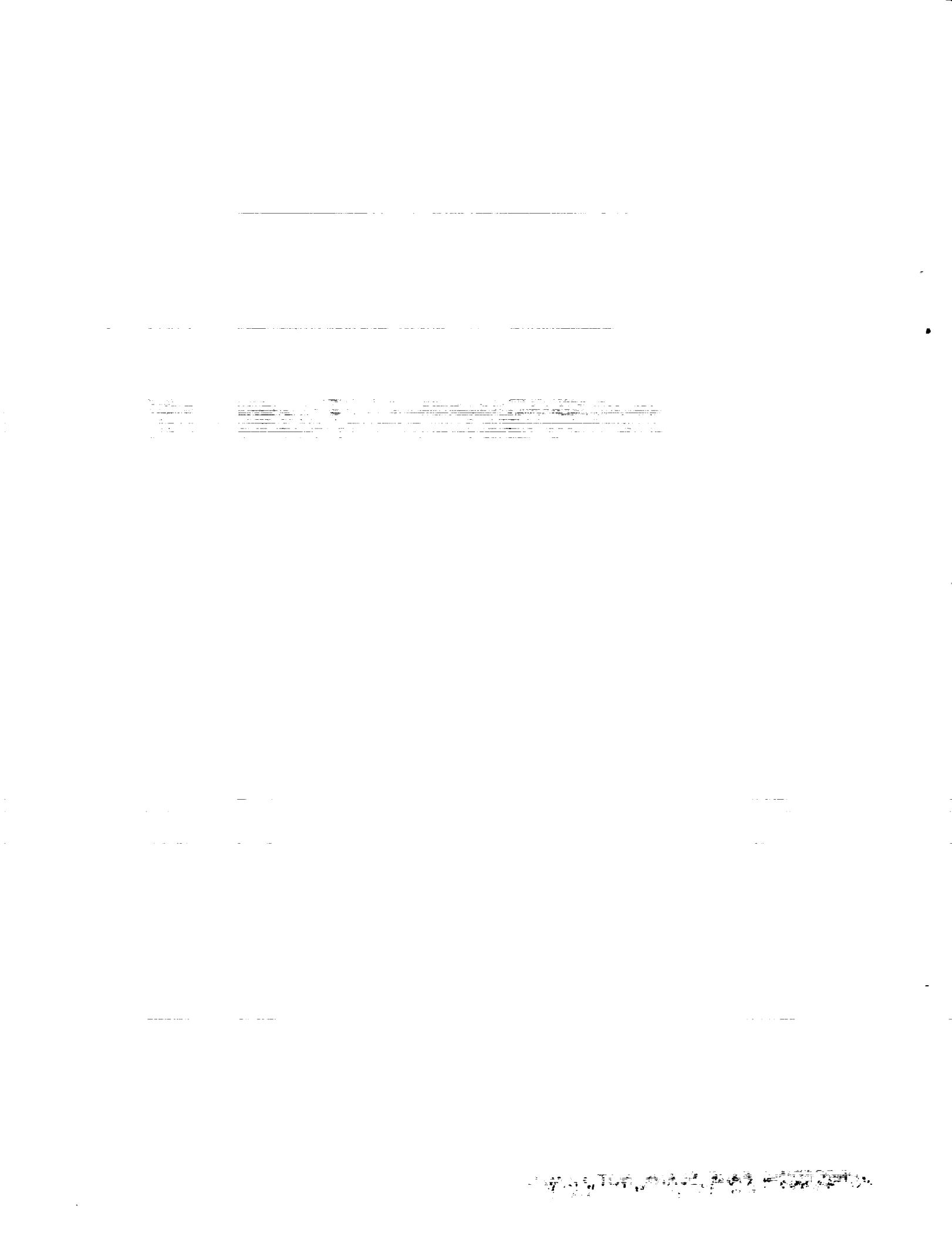


Figure C-62 USMP-2 Port Side of Orbiter Center Line, Vector Magnitude





SUMMARY REPORT OF MISSION ACCELERATION MEASUREMENTS FOR STS-62

Figure C-63 USMP-2 Port Side of Orbiter Center Line, Vector Magnitude

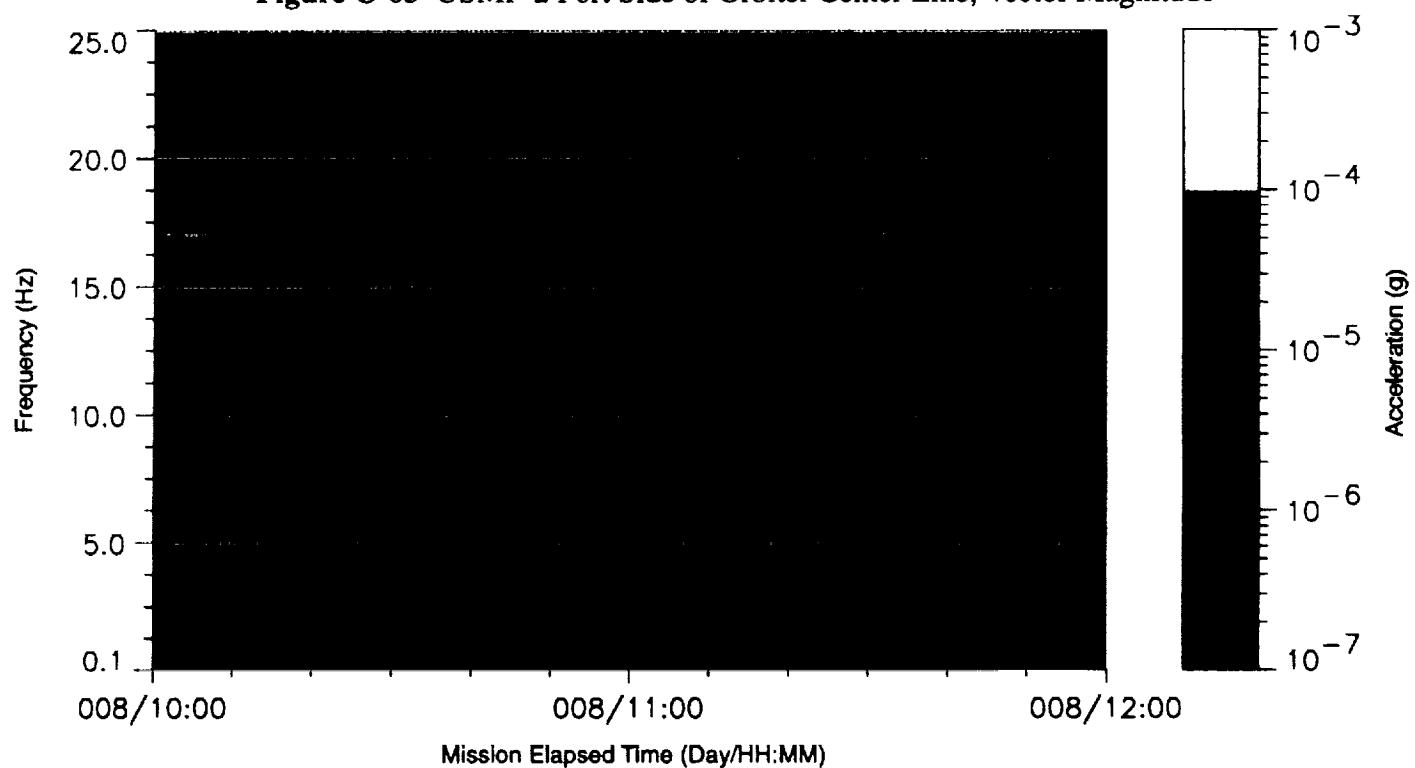
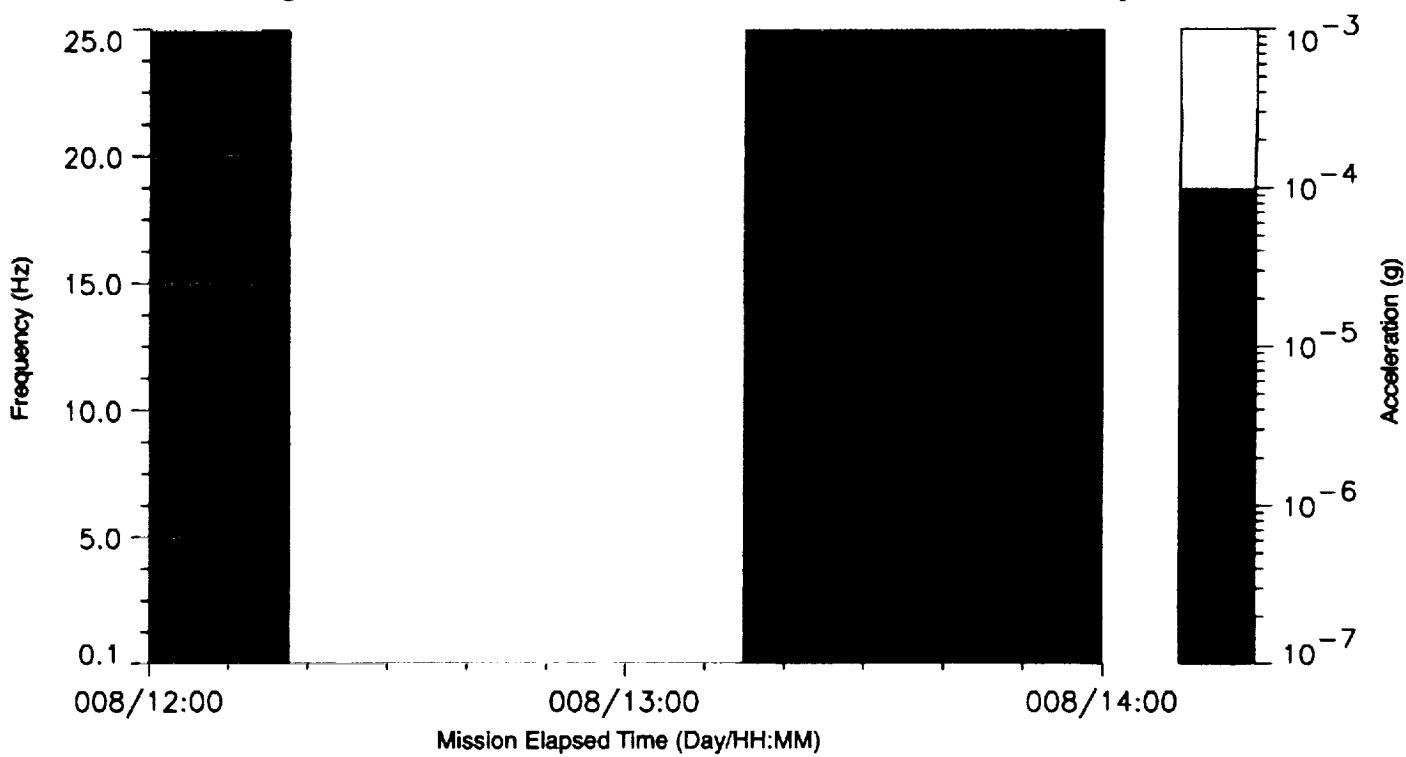
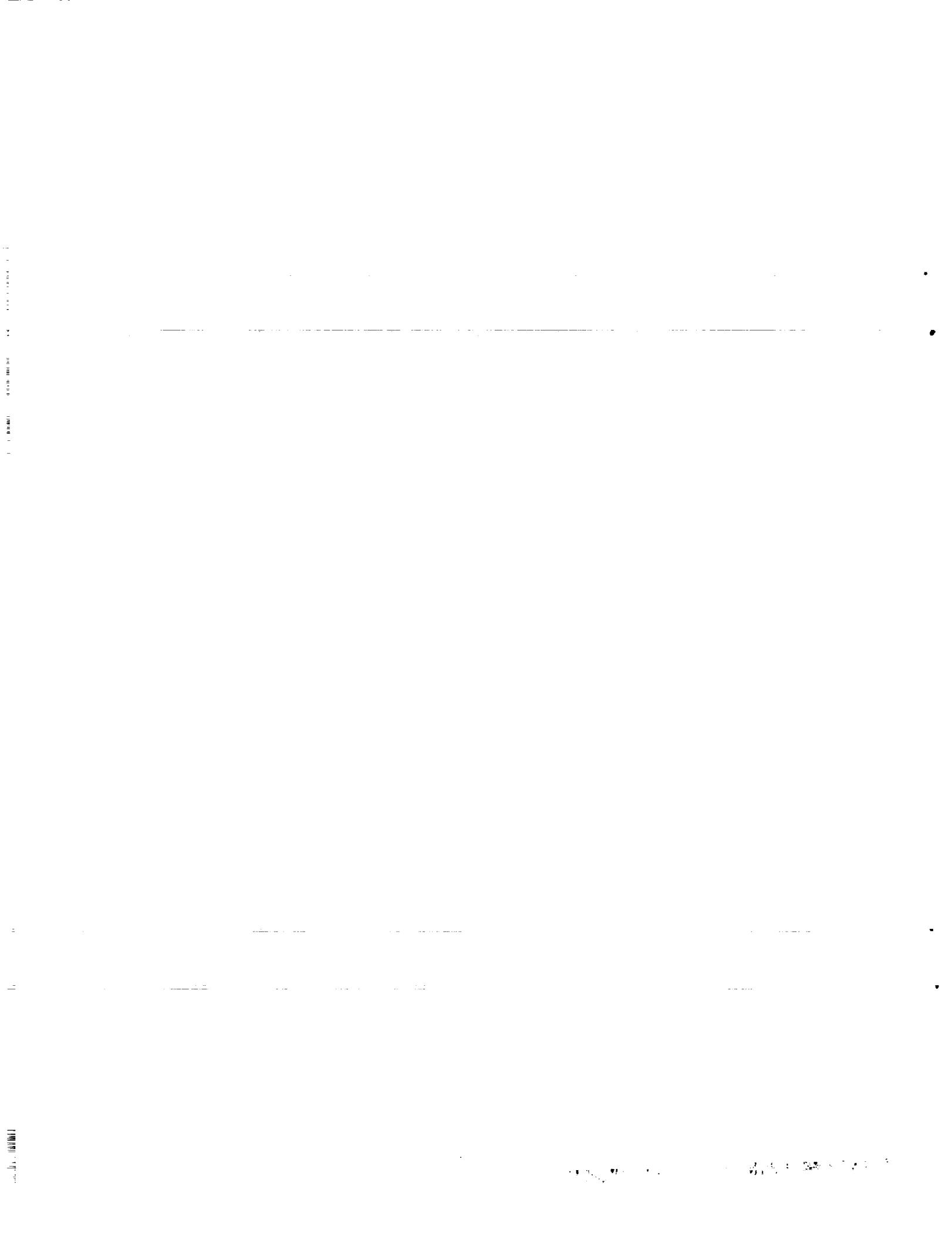


Figure C-64 USMP-2 Port Side of Orbiter Center Line, Vector Magnitude





SUMMARY REPORT OF MISSION ACCELERATION MEASUREMENTS FOR STS-62

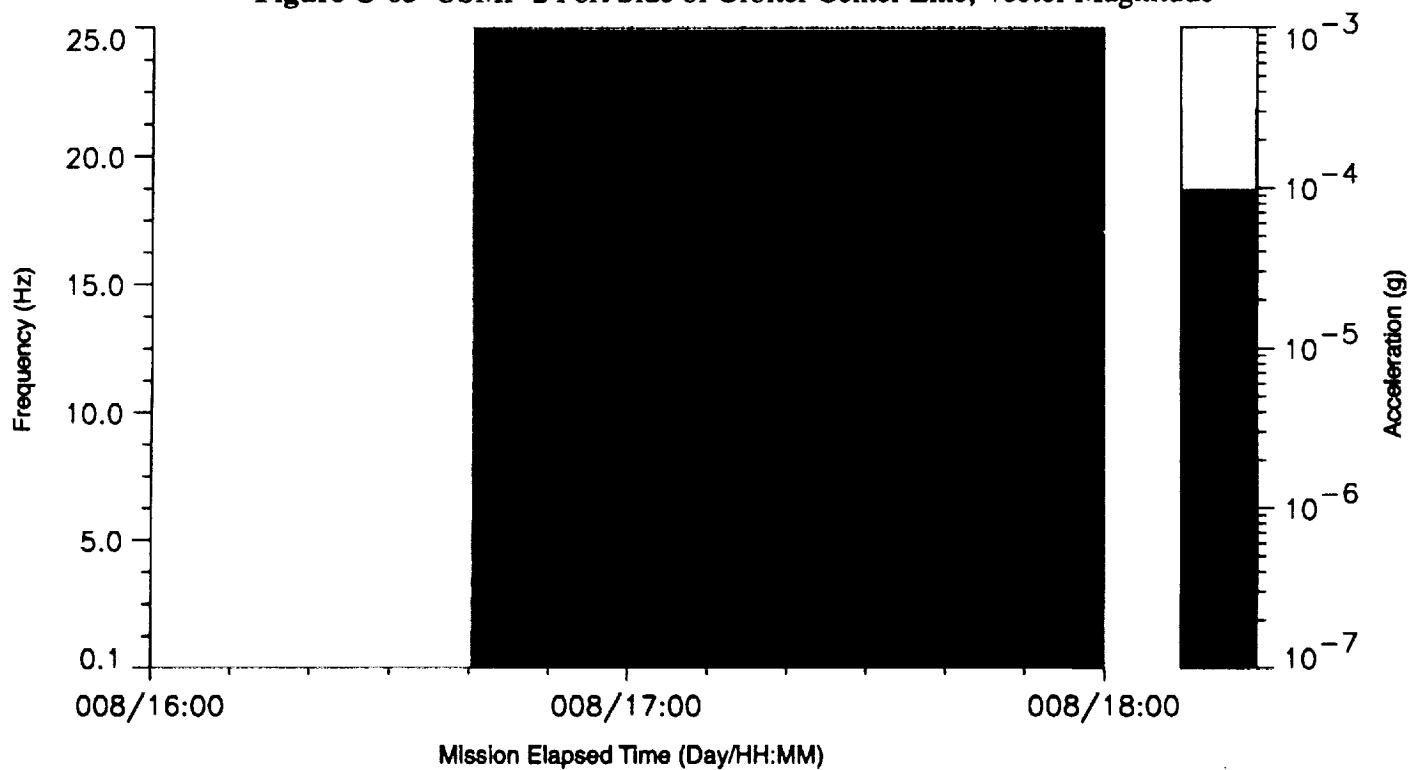
NO DATA AVAILABLE FOR USMP-2, UNIT F, HEAD B

FROM MET 008/14:00:00 - 008/16:40:00



SUMMARY REPORT OF MISSION ACCELERATION MEASUREMENTS FOR STS-62

Figure C-65 USMP-2 Port Side of Orbiter Center Line, Vector Magnitude



NO DATA AVAILABLE FOR USMP-2, UNIT F, HEAD B

FROM MET 008/18:00:00 - 009/00:57:00

SUMMARY REPORT OF MISSION ACCELERATION MEASUREMENTS FOR STS-62

Figure C-66 USMP-2 Port Side of Orbiter Center Line, Vector Magnitude

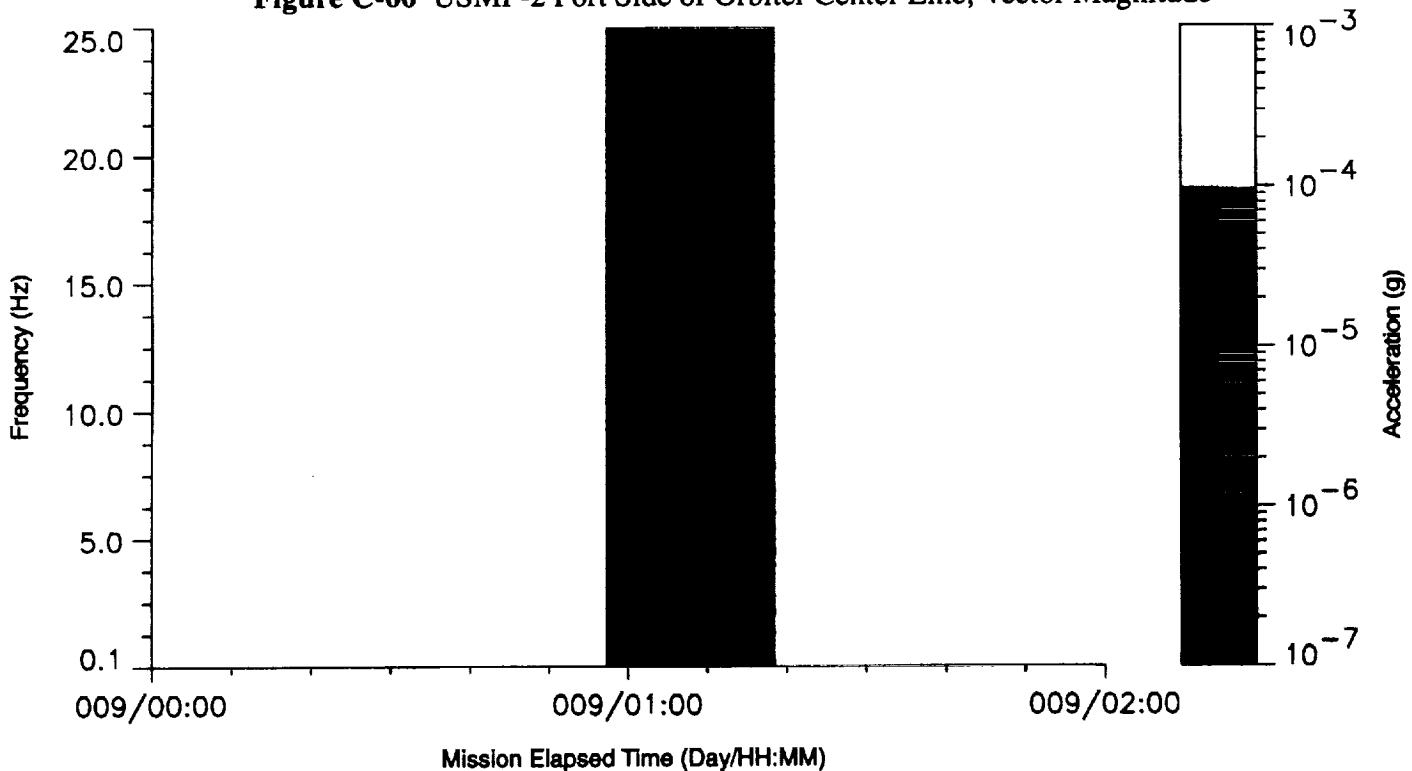
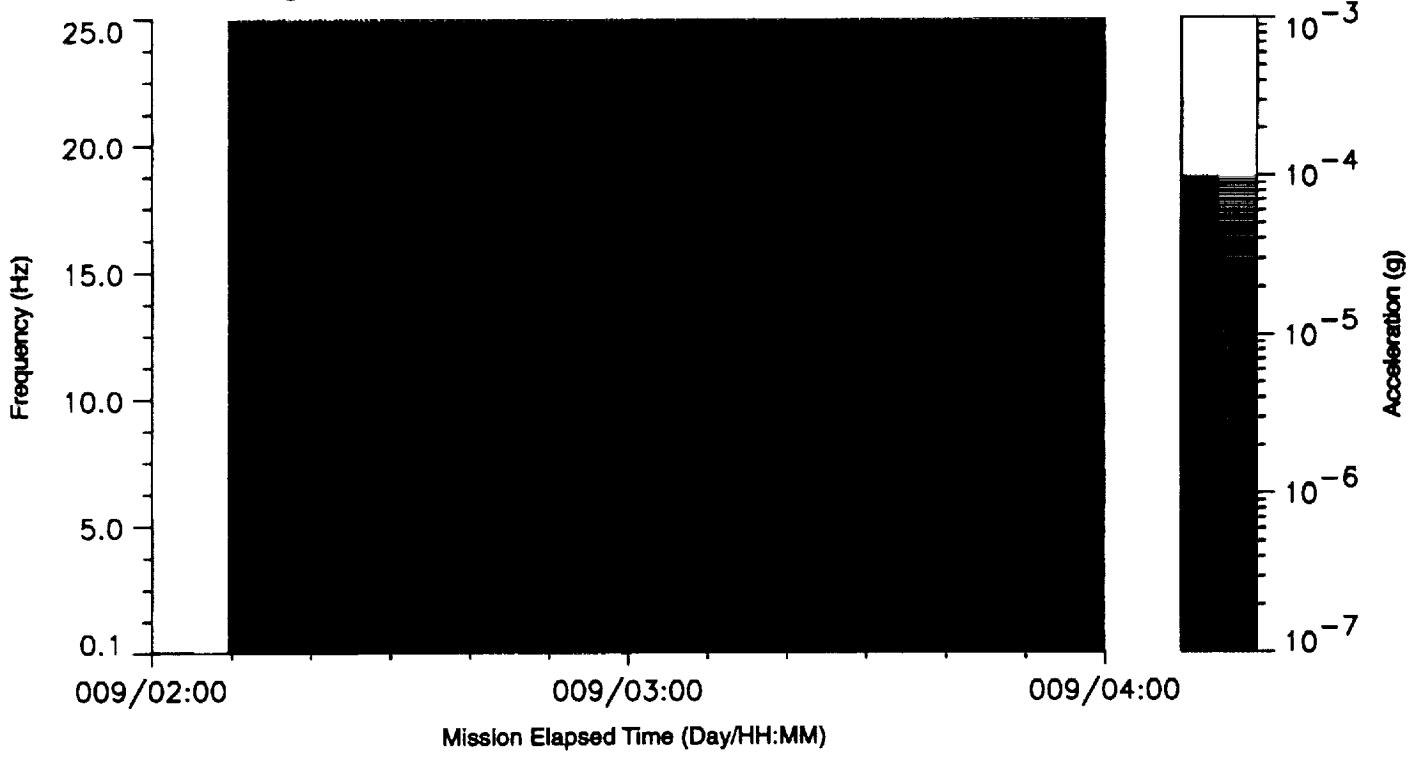


Figure C-67 USMP-2 Port Side of Orbiter Center Line, Vector Magnitude



Howard, Tom and Linda, *Family*, 1990

SUMMARY REPORT OF MISSION ACCELERATION MEASUREMENTS FOR STS-62

Figure C-68 USMP-2 Port Side of Orbiter Center Line, Vector Magnitude

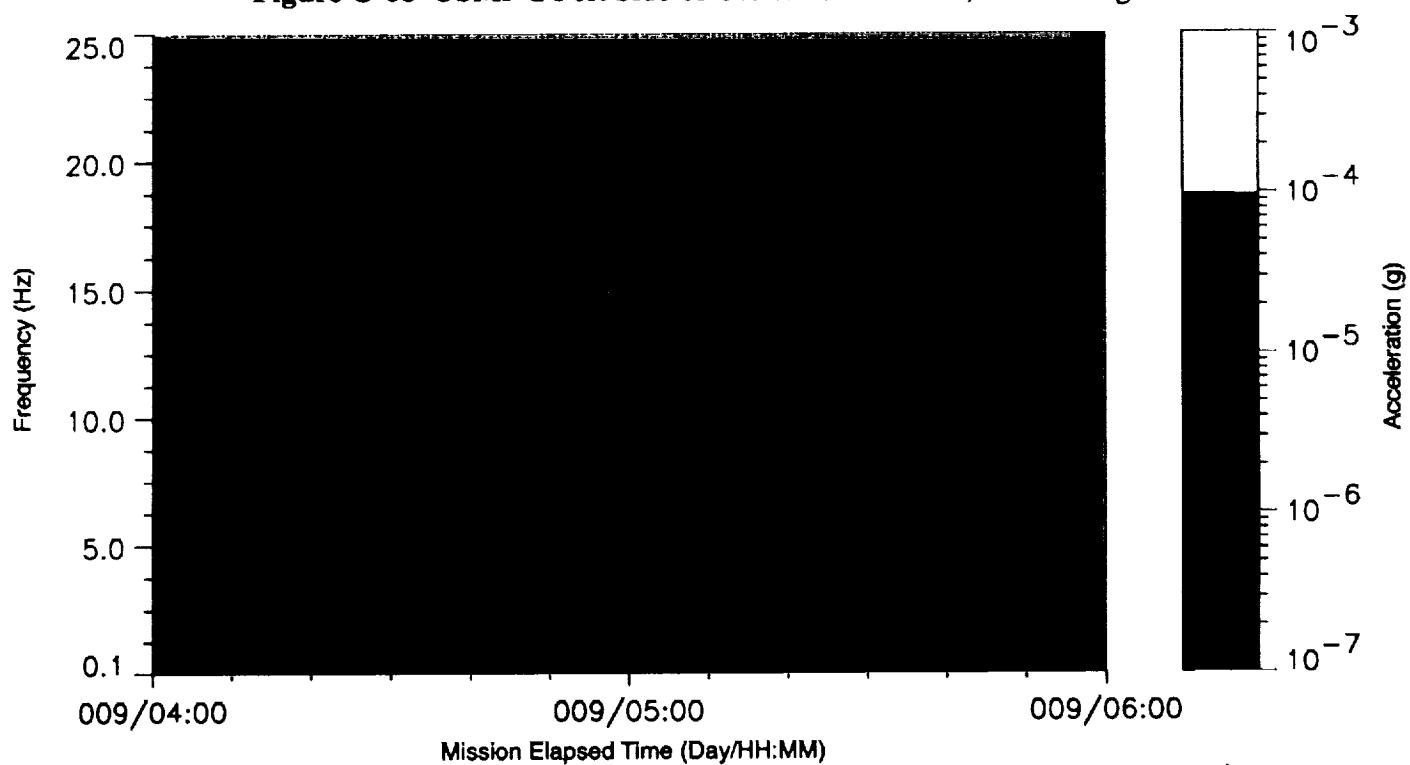
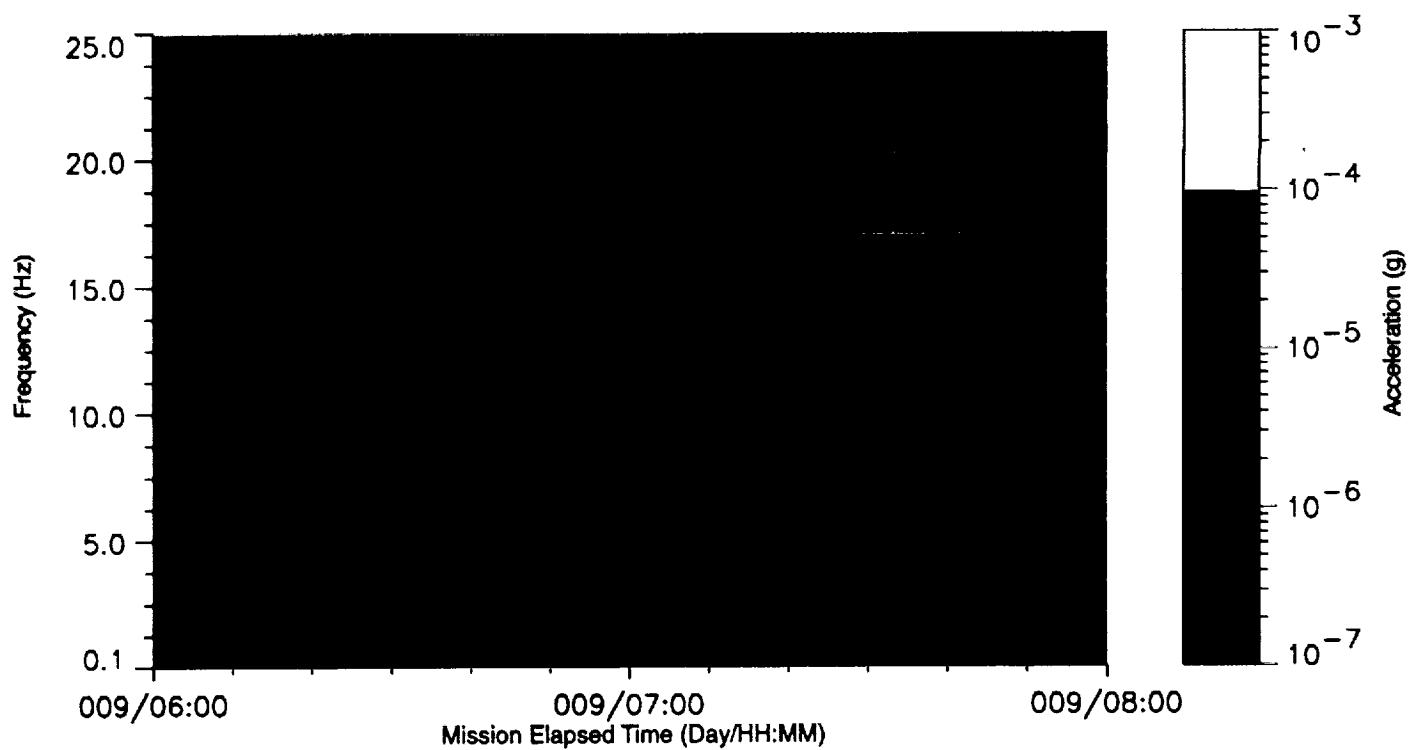


Figure C-69 USMP-2 Port Side of Orbiter Center Line, Vector Magnitude

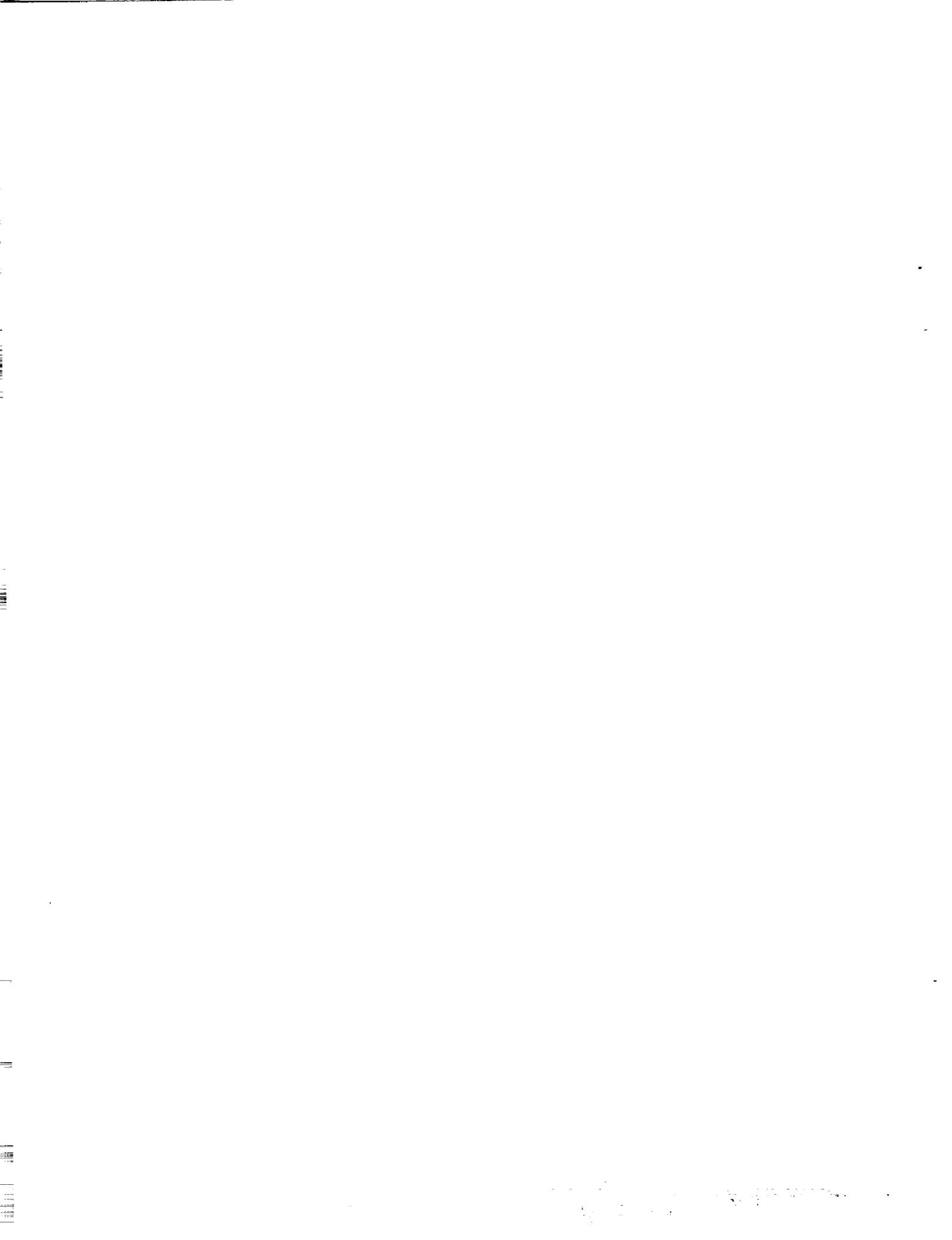




SUMMARY REPORT OF MISSION ACCELERATION MEASUREMENTS FOR STS-62

NO DATA AVAILABLE FOR USMP-2, UNIT F, HEAD B

FROM MET 009/08:00:00 - 009/18:04:00



SUMMARY REPORT OF MISSION ACCELERATION MEASUREMENTS FOR STS-62

Figure C-70 USMP-2 Port Side of Orbiter Center Line, Vector Magnitude

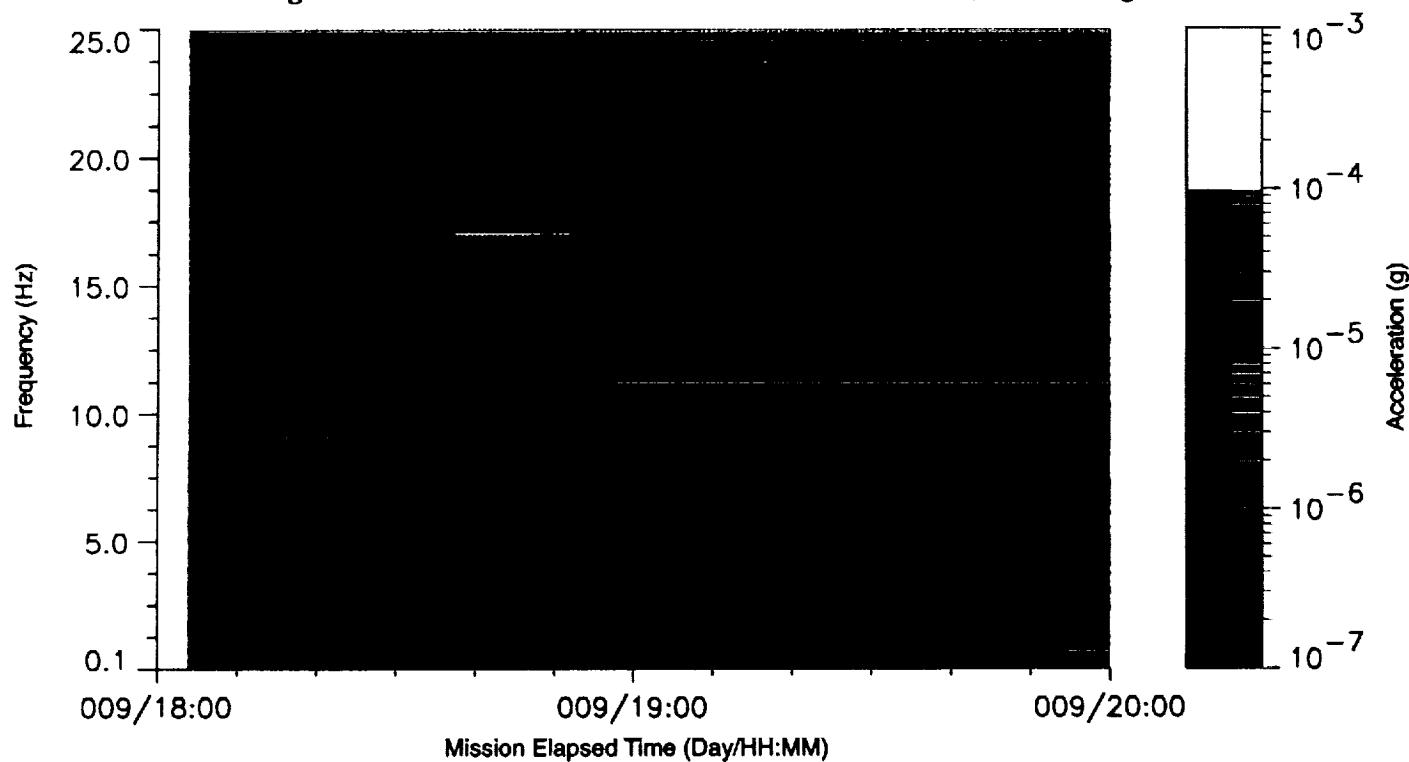
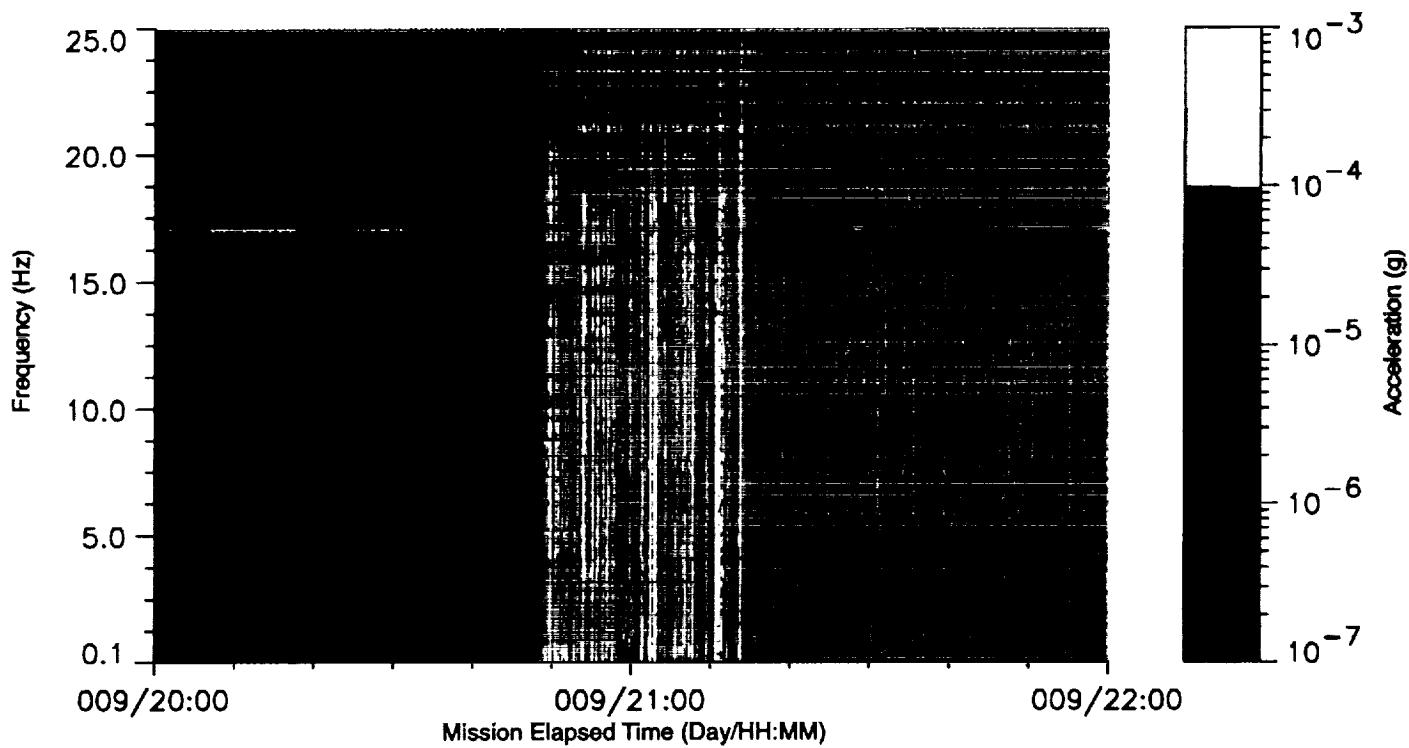


Figure C-71 USMP-2 Port Side of Orbiter Center Line, Vector Magnitude





SUMMARY REPORT OF MISSION ACCELERATION MEASUREMENTS FOR STS-62

Figure C-72 USMP-2 Port Side of Orbiter Center Line, Vector Magnitude

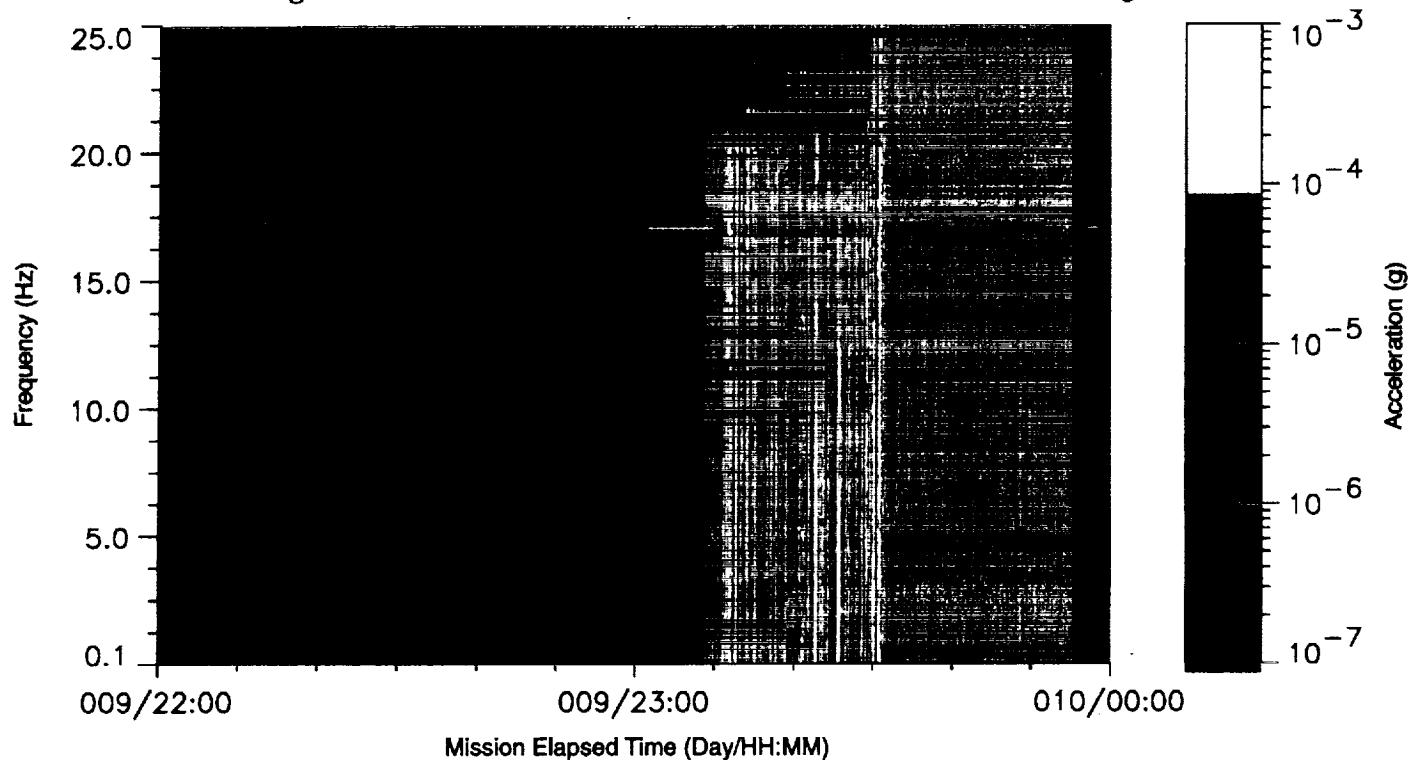
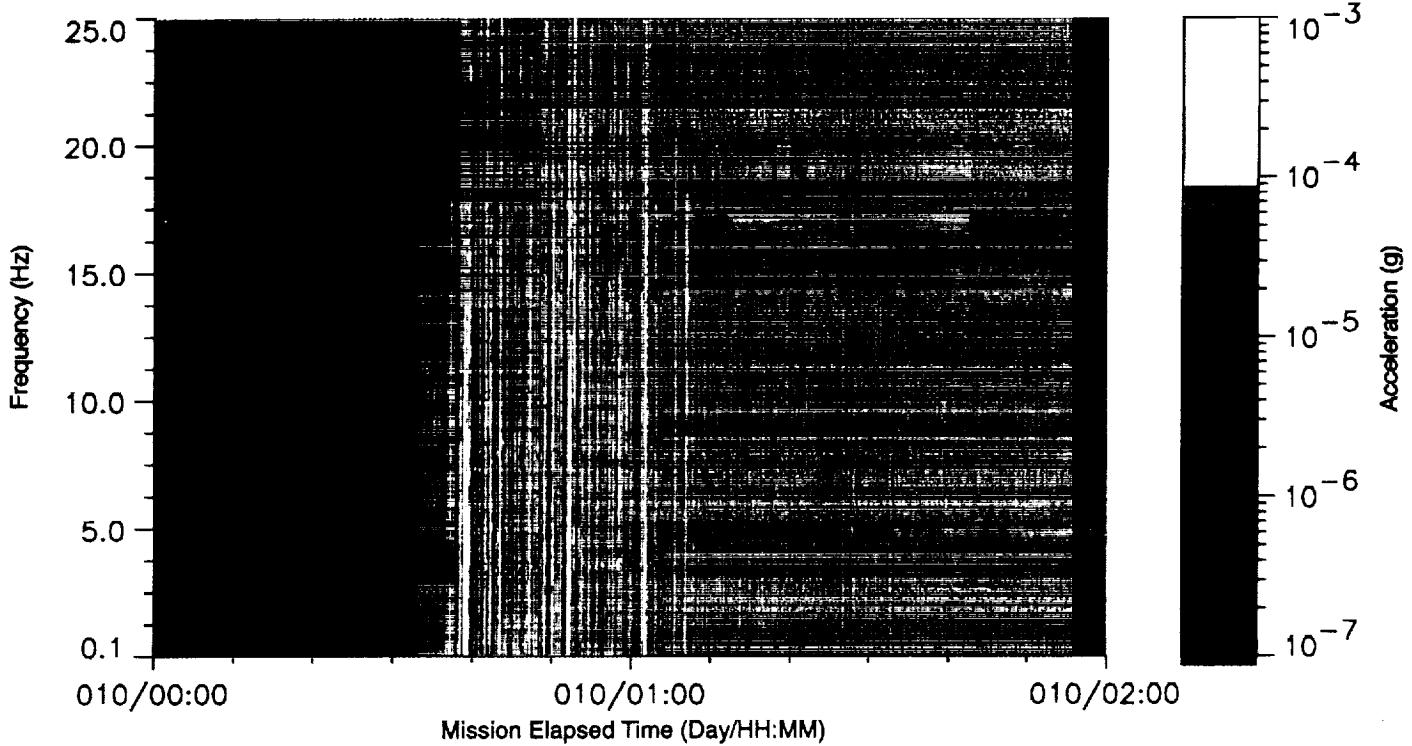


Figure C-73 USMP-2 Port Side of Orbiter Center Line, Vector Magnitude





SUMMARY REPORT OF MISSION ACCELERATION MEASUREMENTS FOR STS-62

Figure C-74 USMP-2 Port Side of Orbiter Center Line, Vector Magnitude

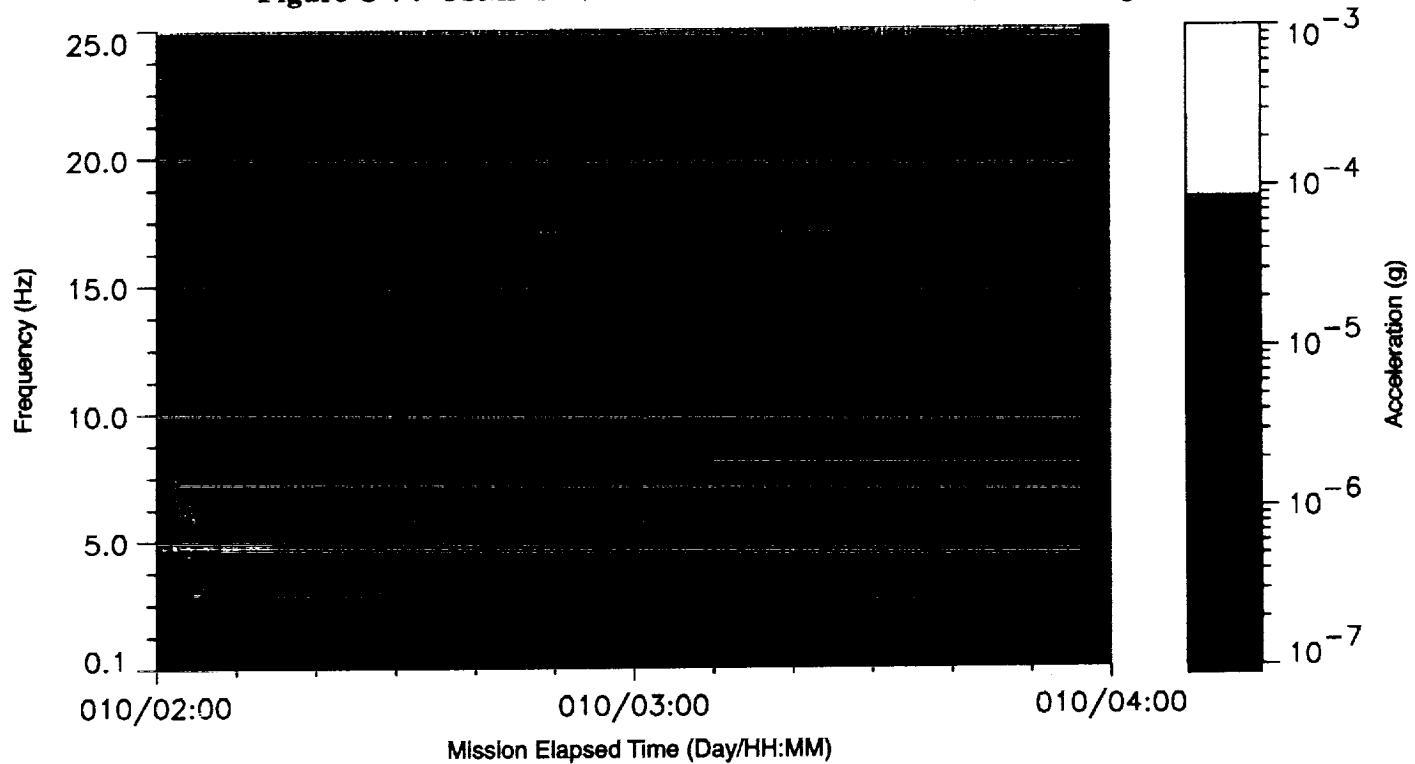
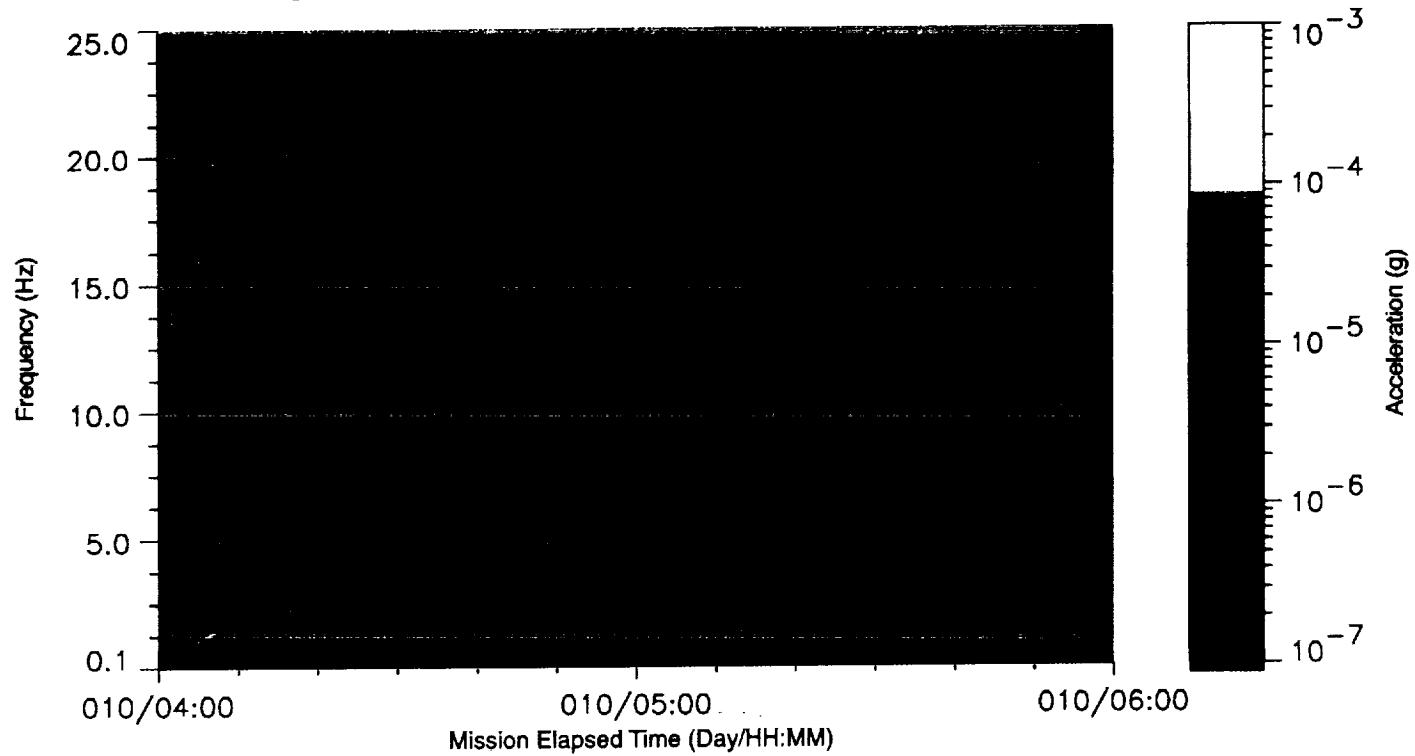


Figure C-75 USMP-2 Port Side of Orbiter Center Line, Vector Magnitude





SUMMARY REPORT OF MISSION ACCELERATION MEASUREMENTS FOR STS-62

Figure C-76 USMP-2 Port Side of Orbiter Center Line, Vector Magnitude

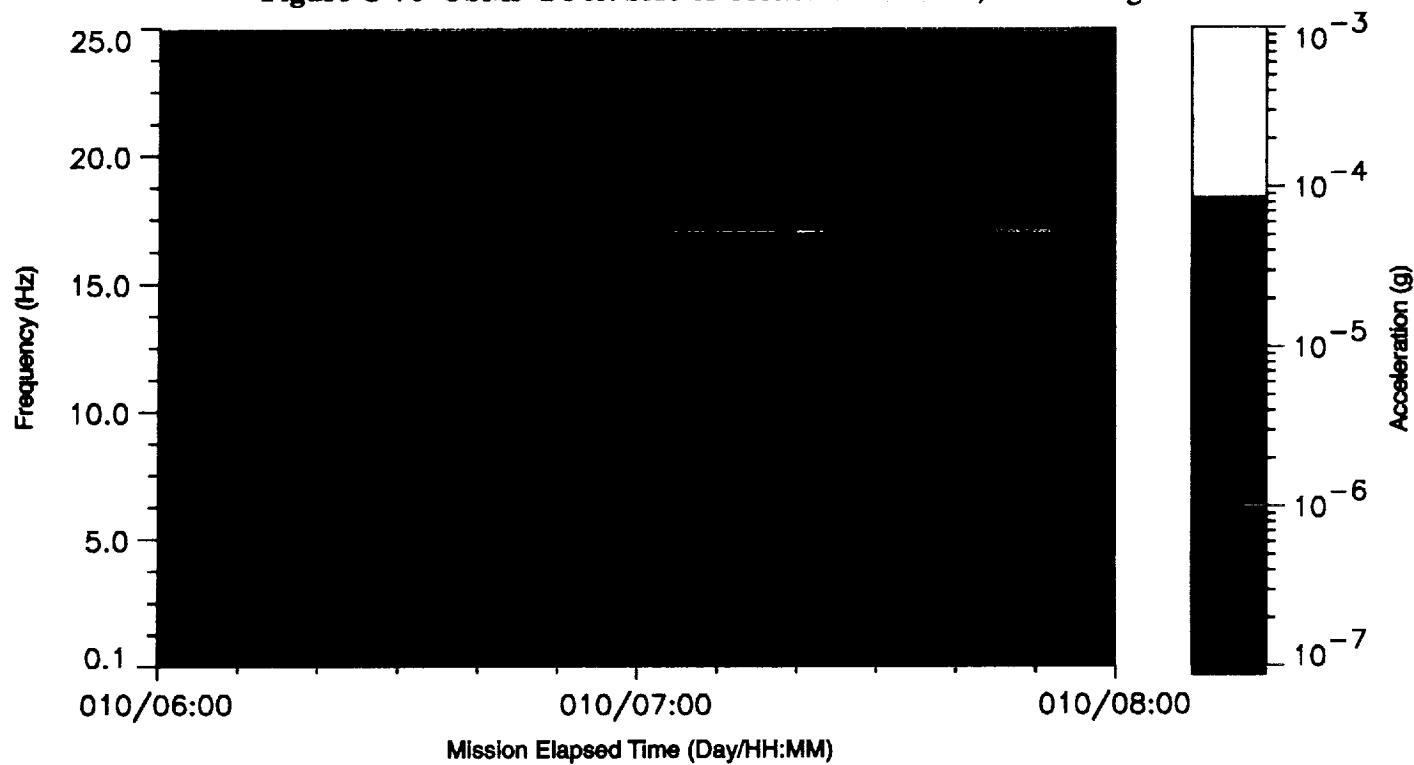
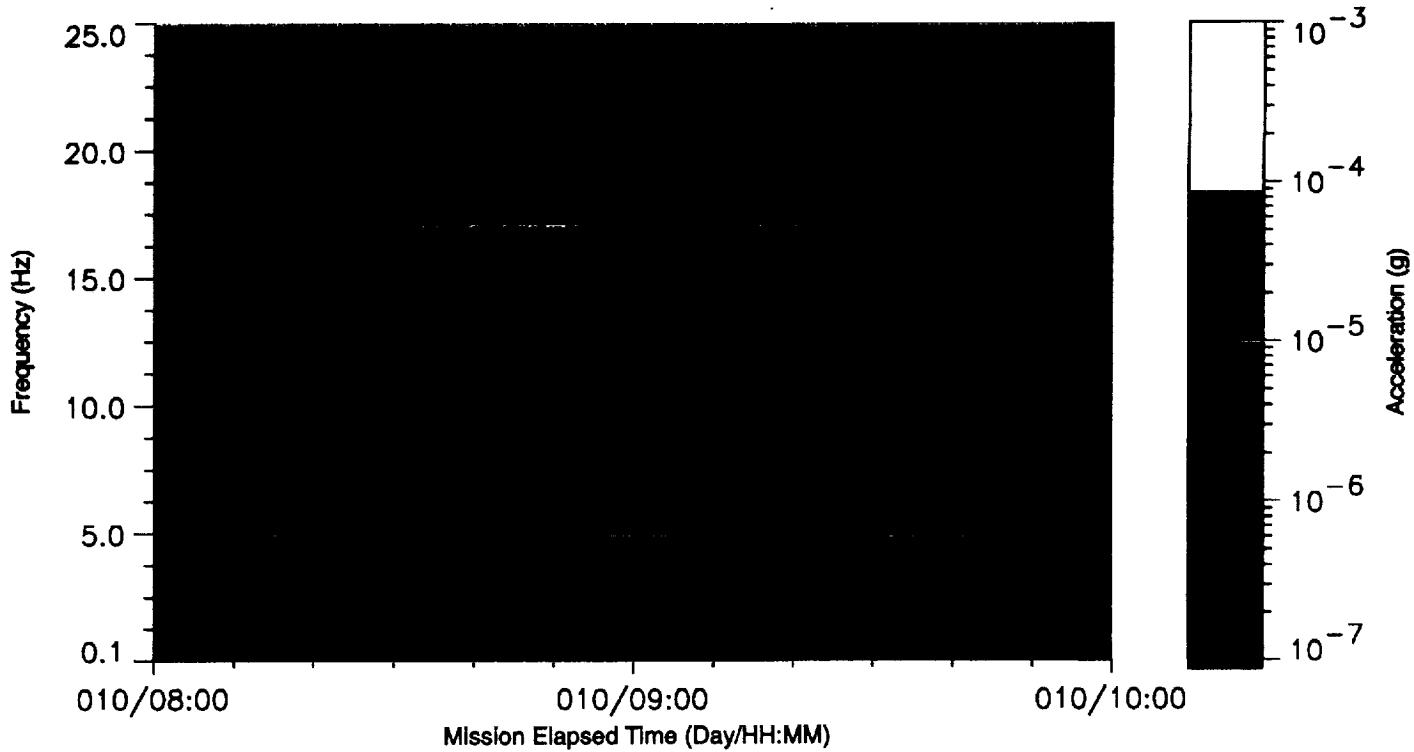


Figure C-77 USMP-2 Port Side of Orbiter Center Line, Vector Magnitude



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SUMMARY REPORT OF MISSION ACCELERATION MEASUREMENTS FOR STS-62

Figure C-78 USMP-2 Port Side of Orbiter Center Line, Vector Magnitude

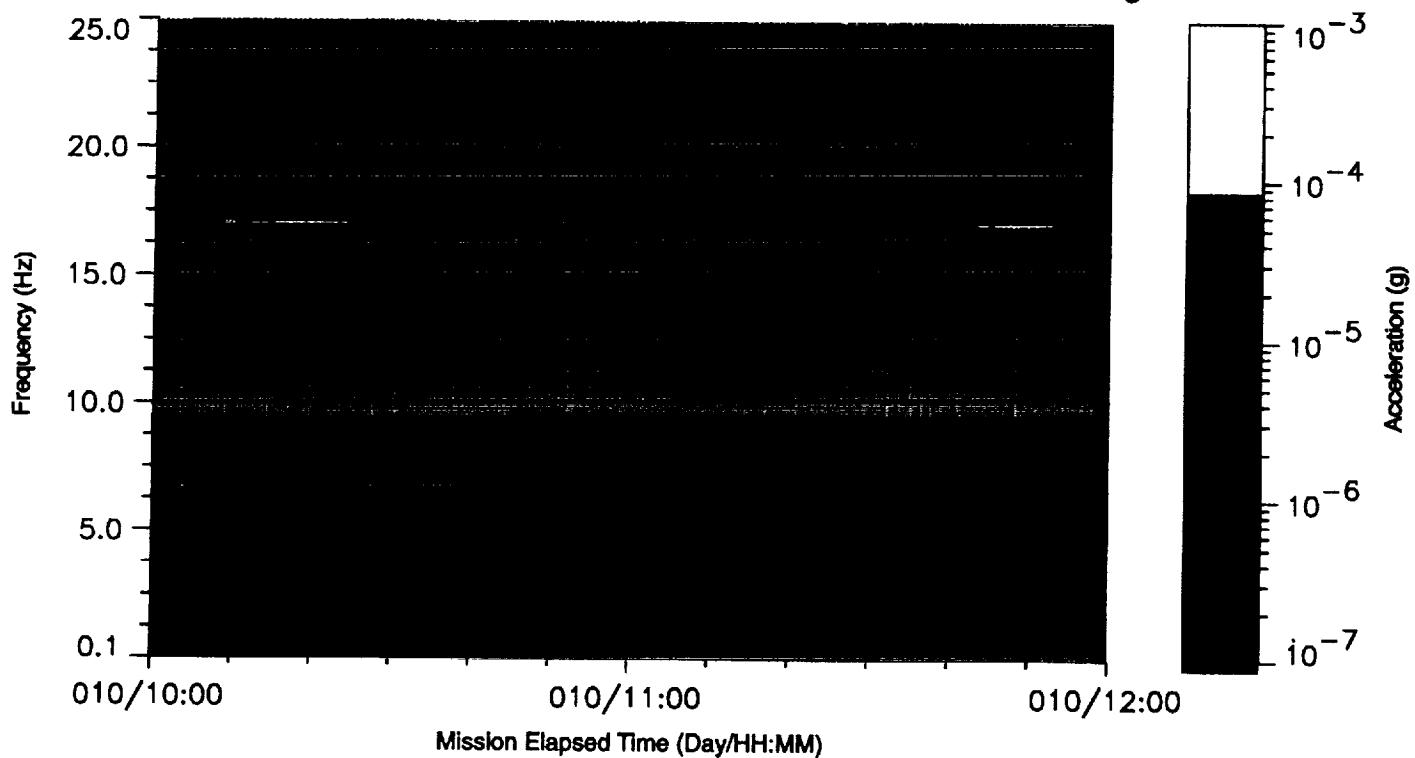
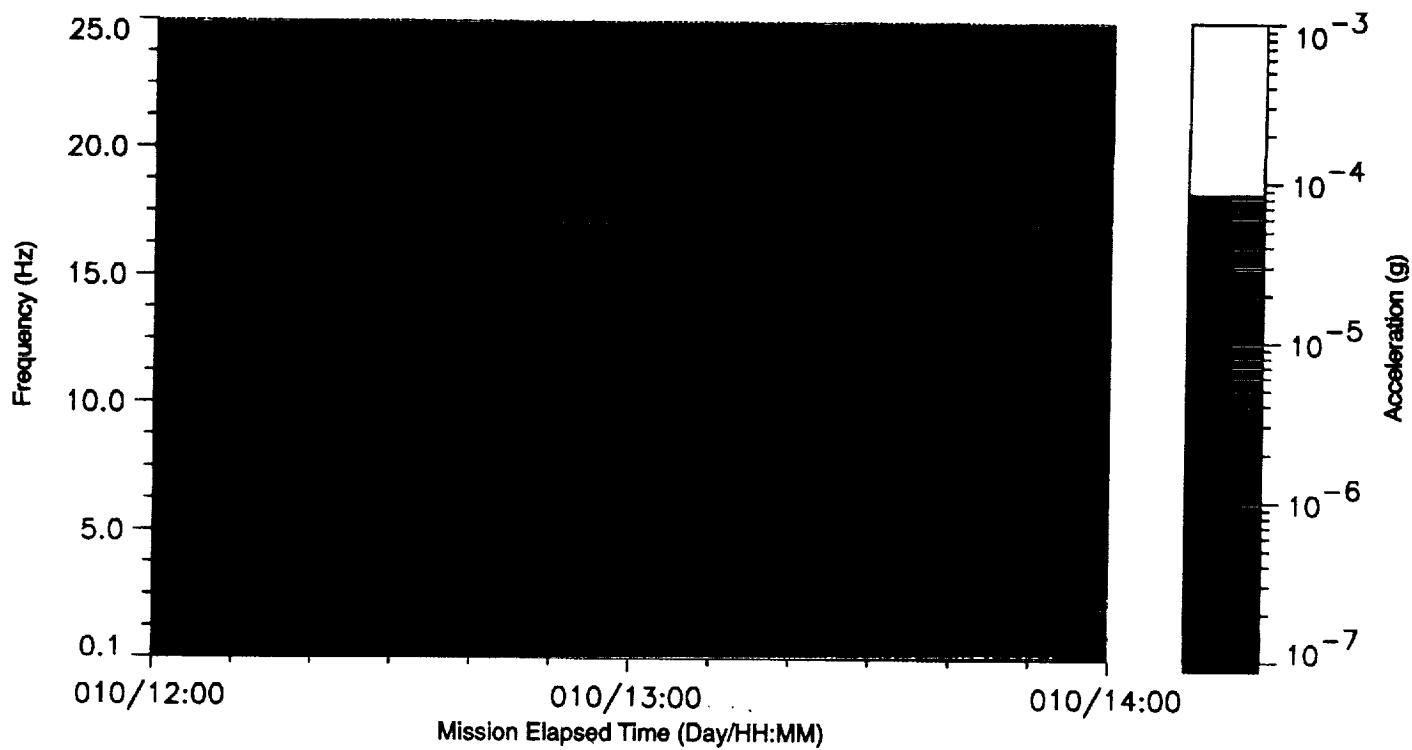


Figure C-79 USMP-2 Port Side of Orbiter Center Line, Vector Magnitude



SUMMARY REPORT OF MISSION ACCELERATION MEASUREMENTS FOR STS-62

Figure C-80 USMP-2 Port Side of Orbiter Center Line, Vector Magnitude

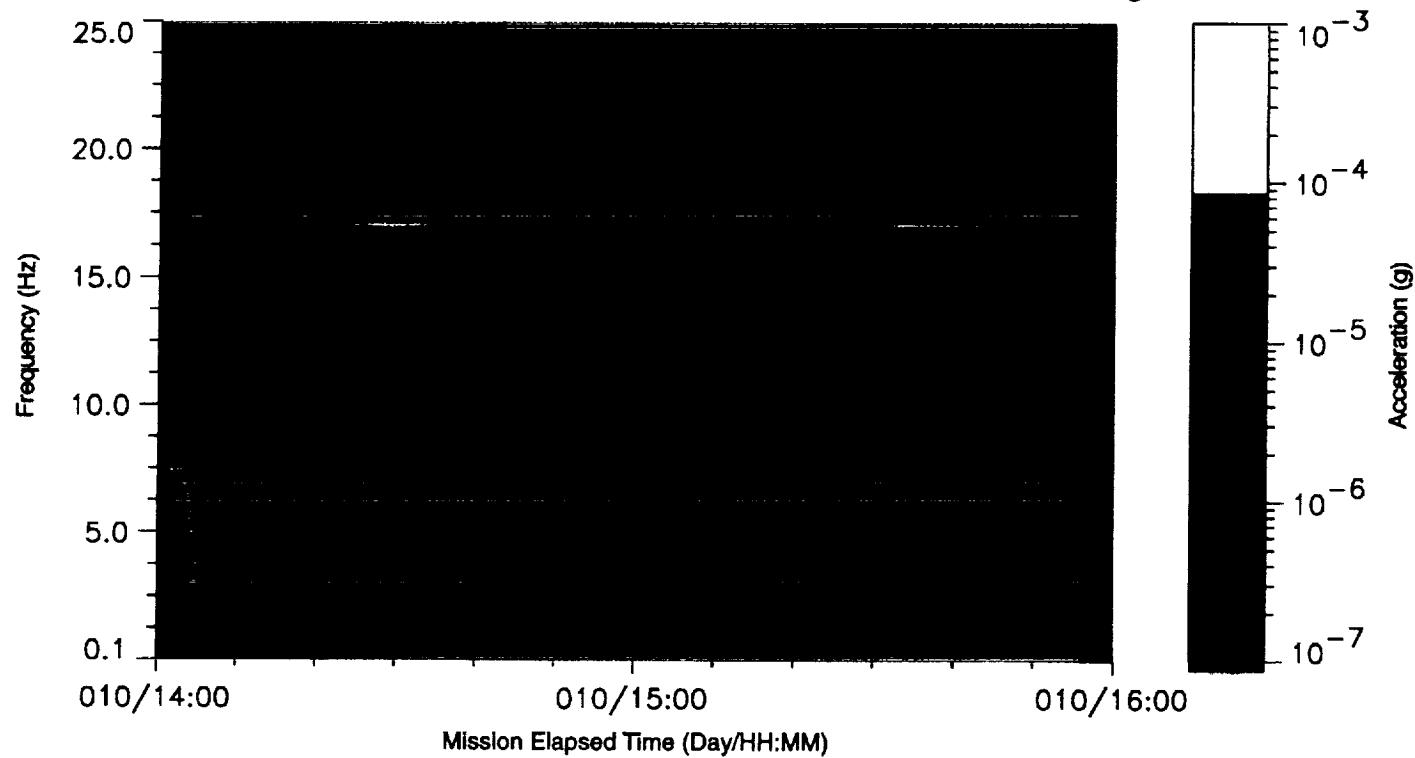
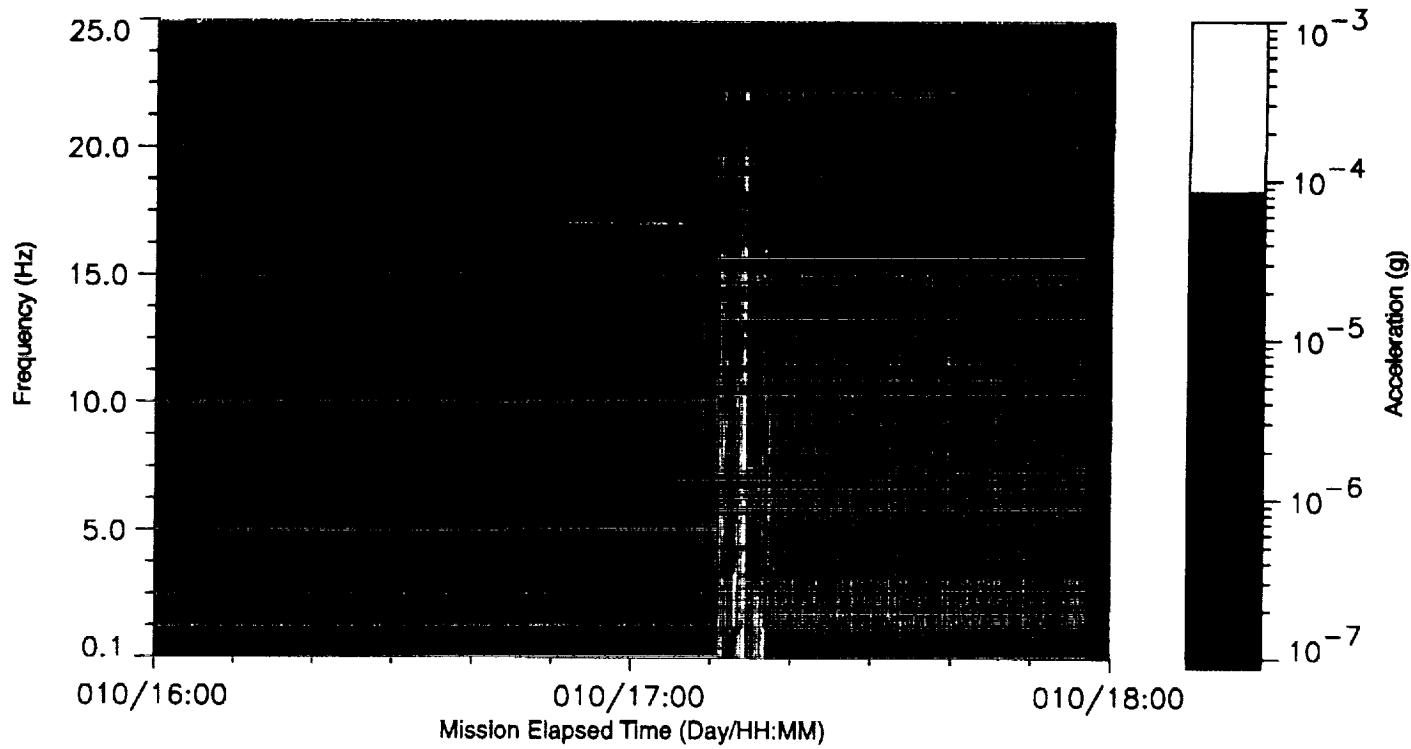
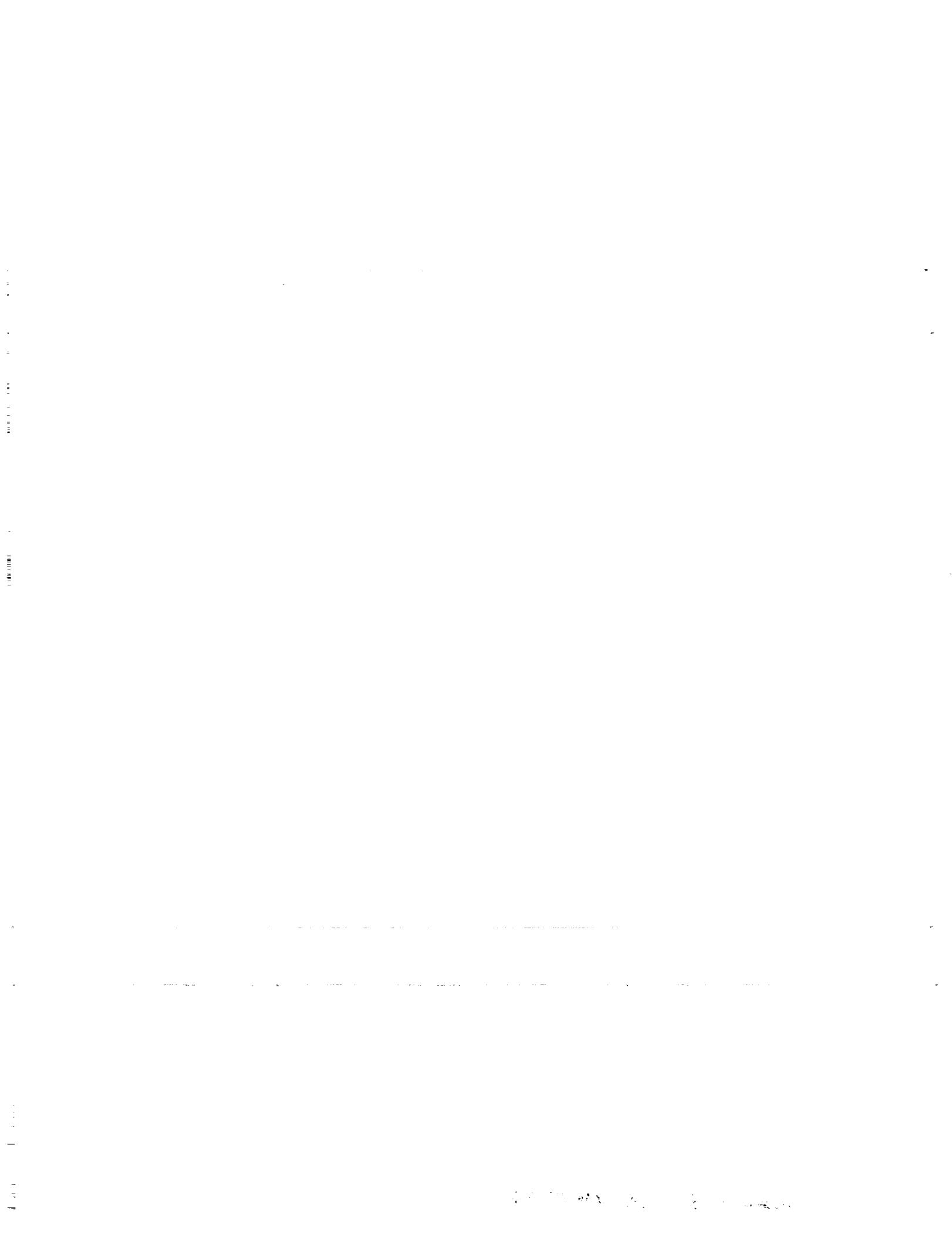


Figure C-81 USMP-2 Port Side of Orbiter Center Line, Vector Magnitude





SUMMARY REPORT OF MISSION ACCELERATION MEASUREMENTS FOR STS-62

Figure C-82 USMP-2 Port Side of Orbiter Center Line, Vector Magnitude

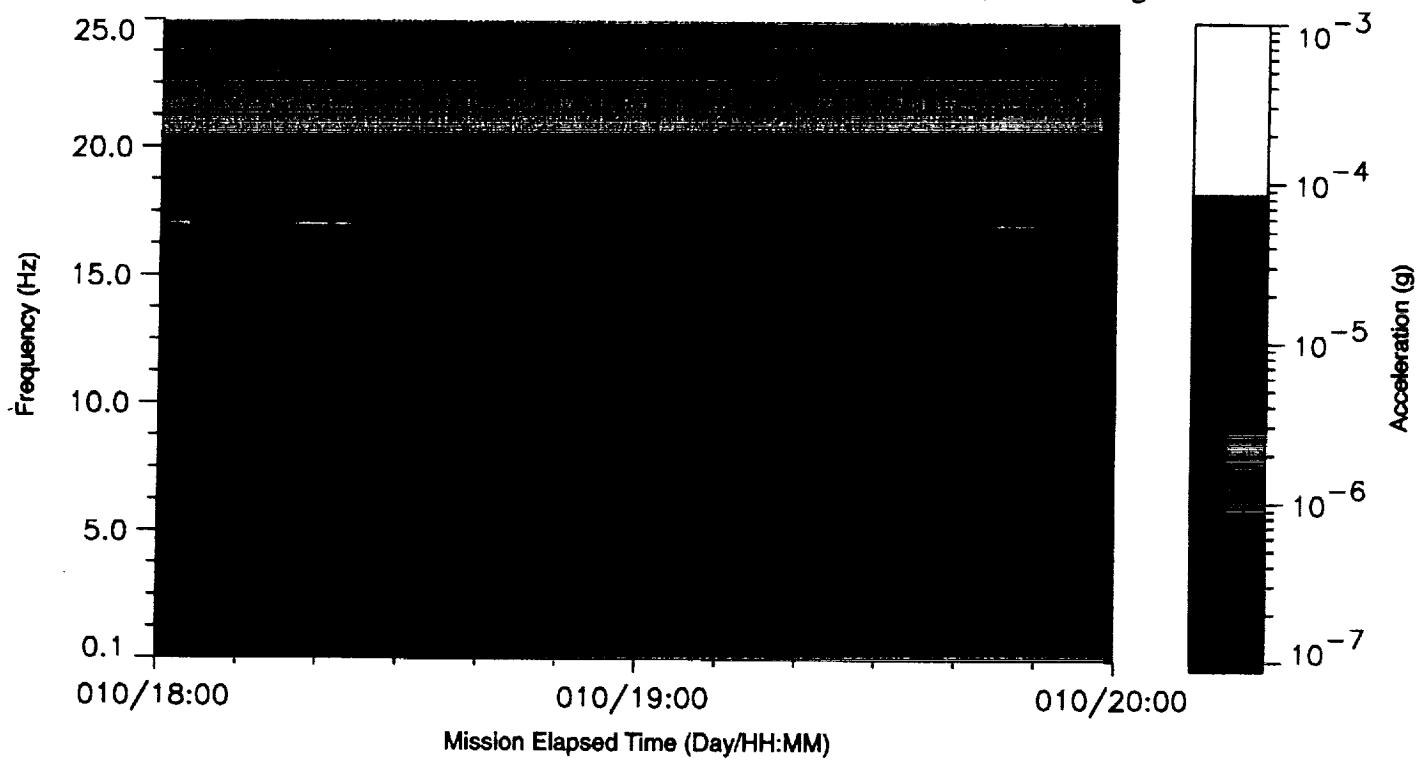
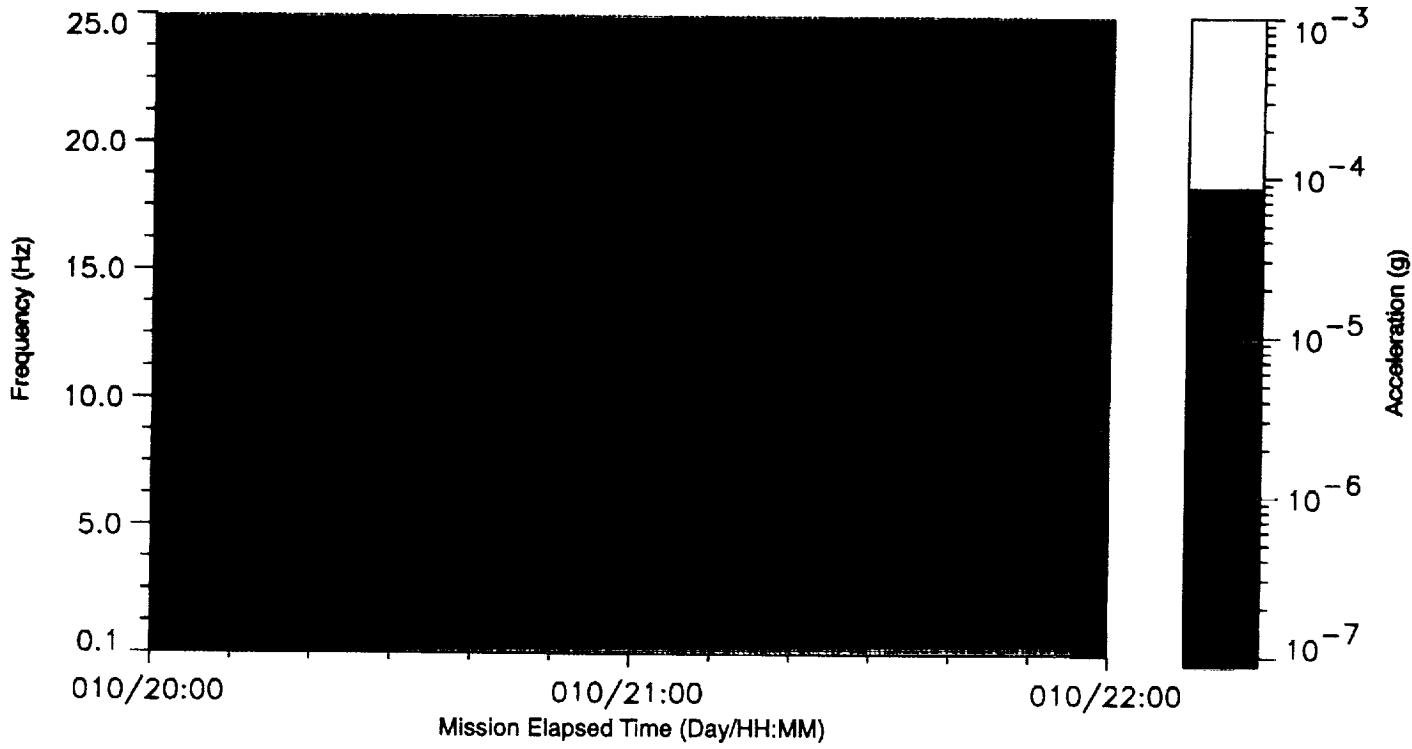


Figure C-83 USMP-2 Port Side of Orbiter Center Line, Vector Magnitude





SUMMARY REPORT OF MISSION ACCELERATION MEASUREMENTS FOR STS-62

Figure C-84 USMP-2 Port Side of Orbiter Center Line, Vector Magnitude

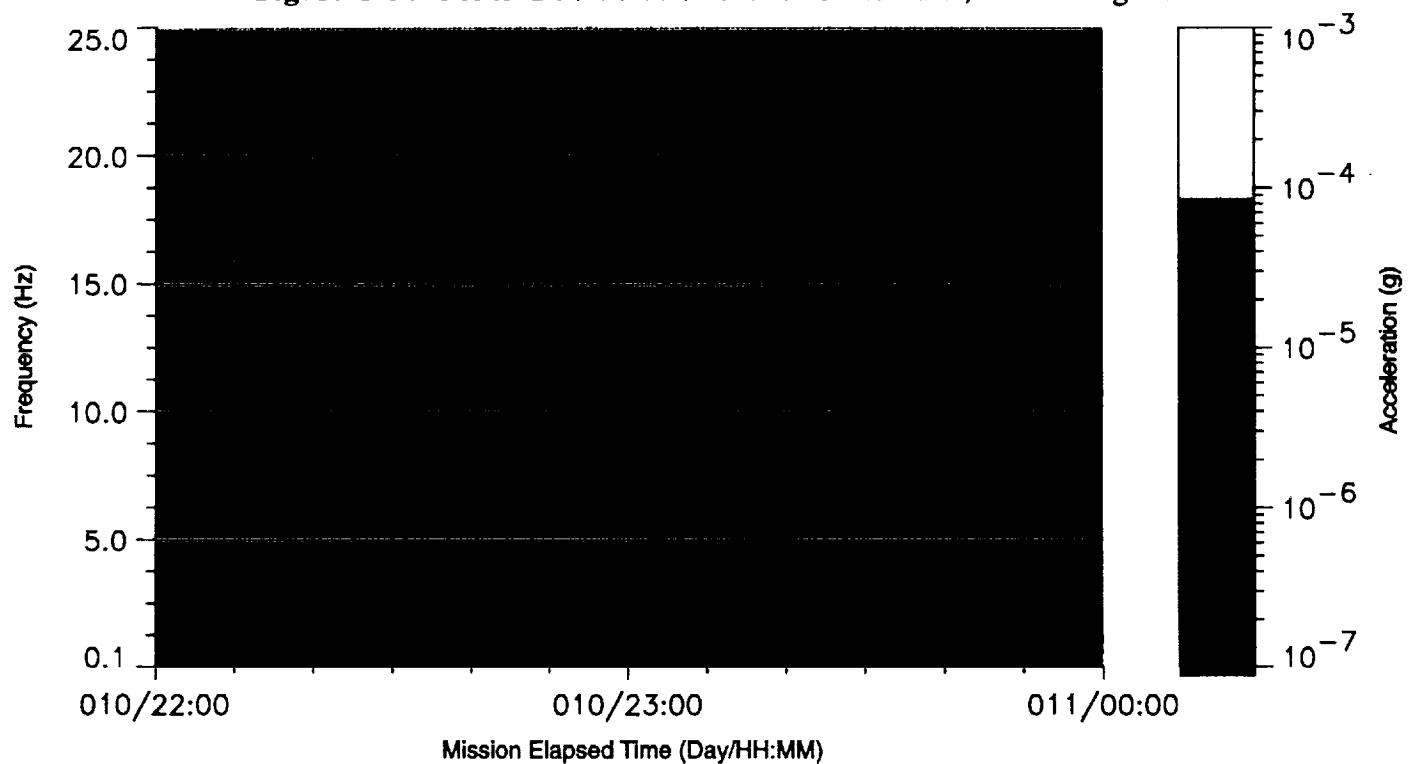
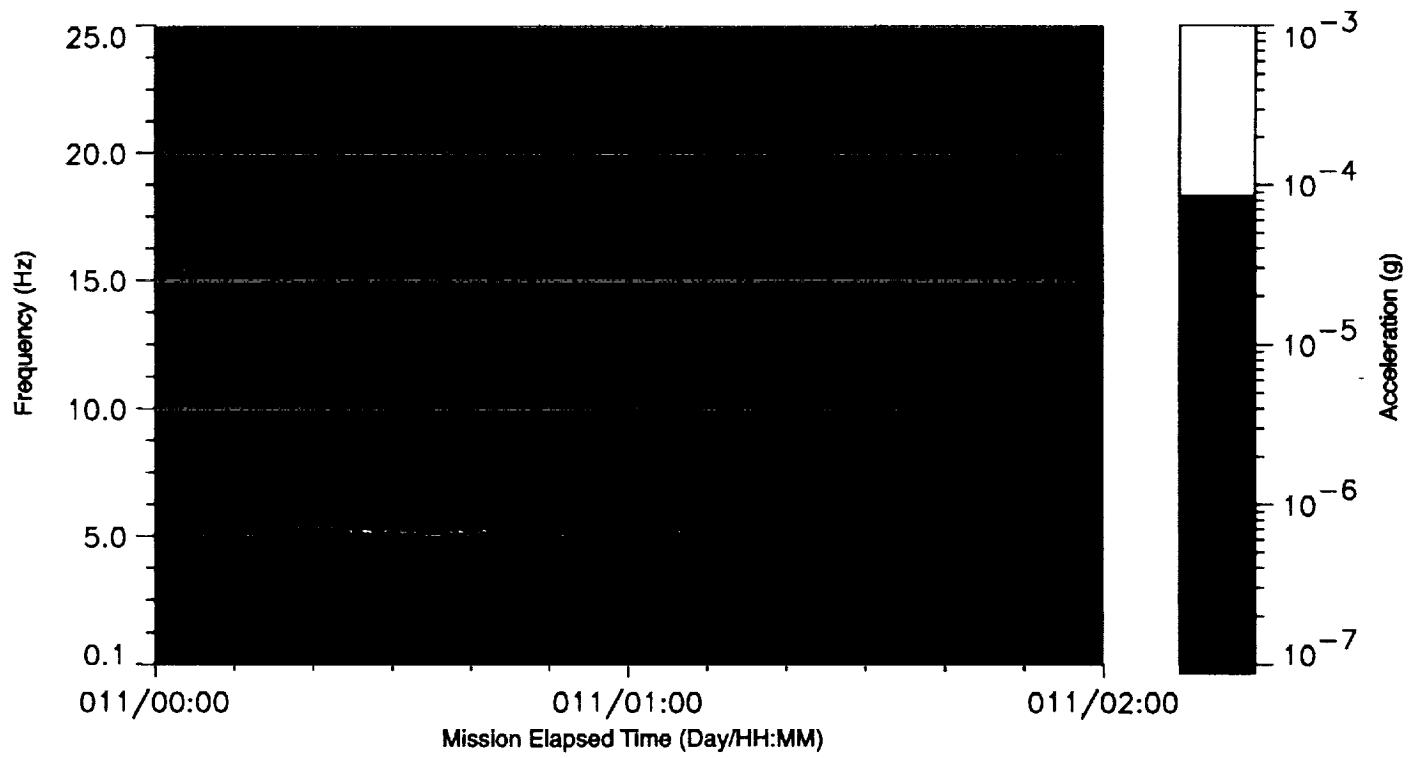


Figure C-85 USMP-2 Port Side of Orbiter Center Line, Vector Magnitude





SUMMARY REPORT OF MISSION ACCELERATION MEASUREMENTS FOR STS-62

Figure C-86 USMP-2 Port Side of Orbiter Center Line, Vector Magnitude

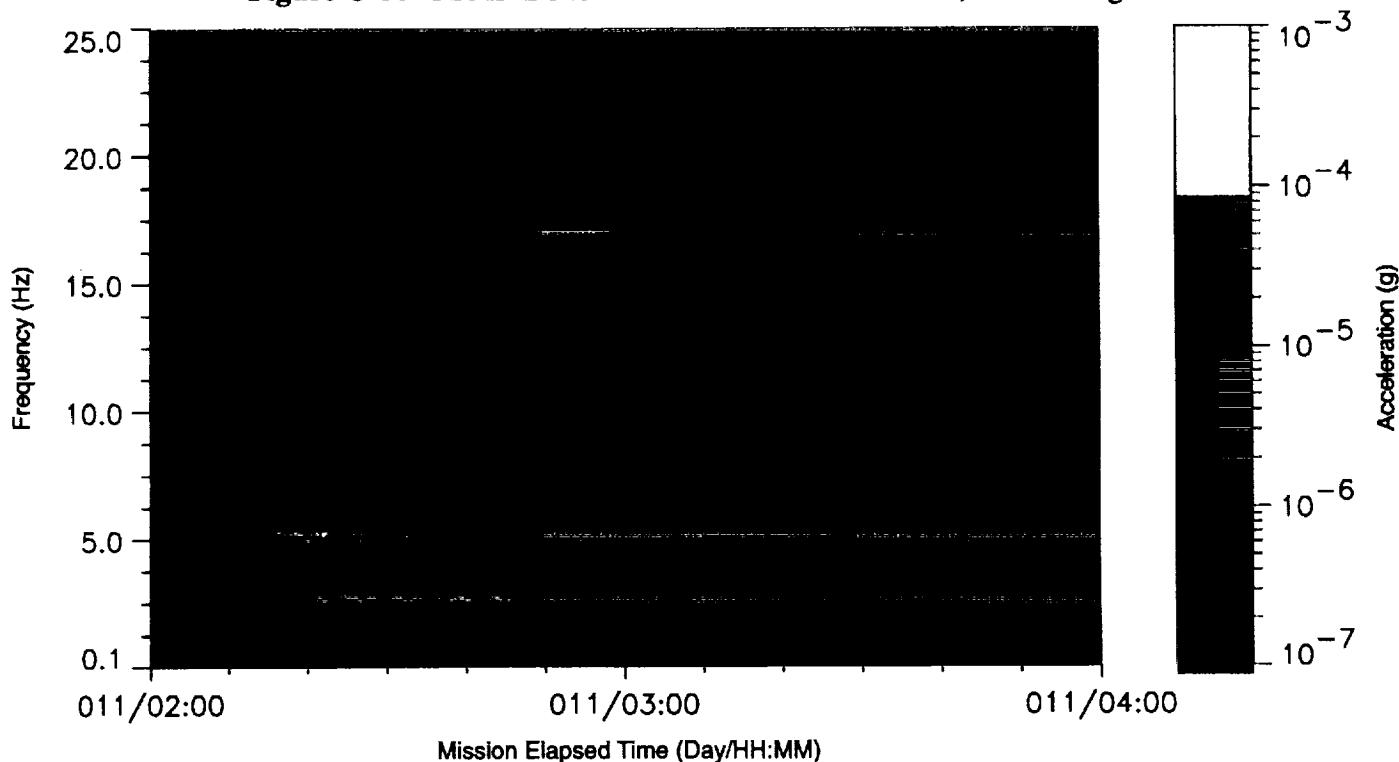
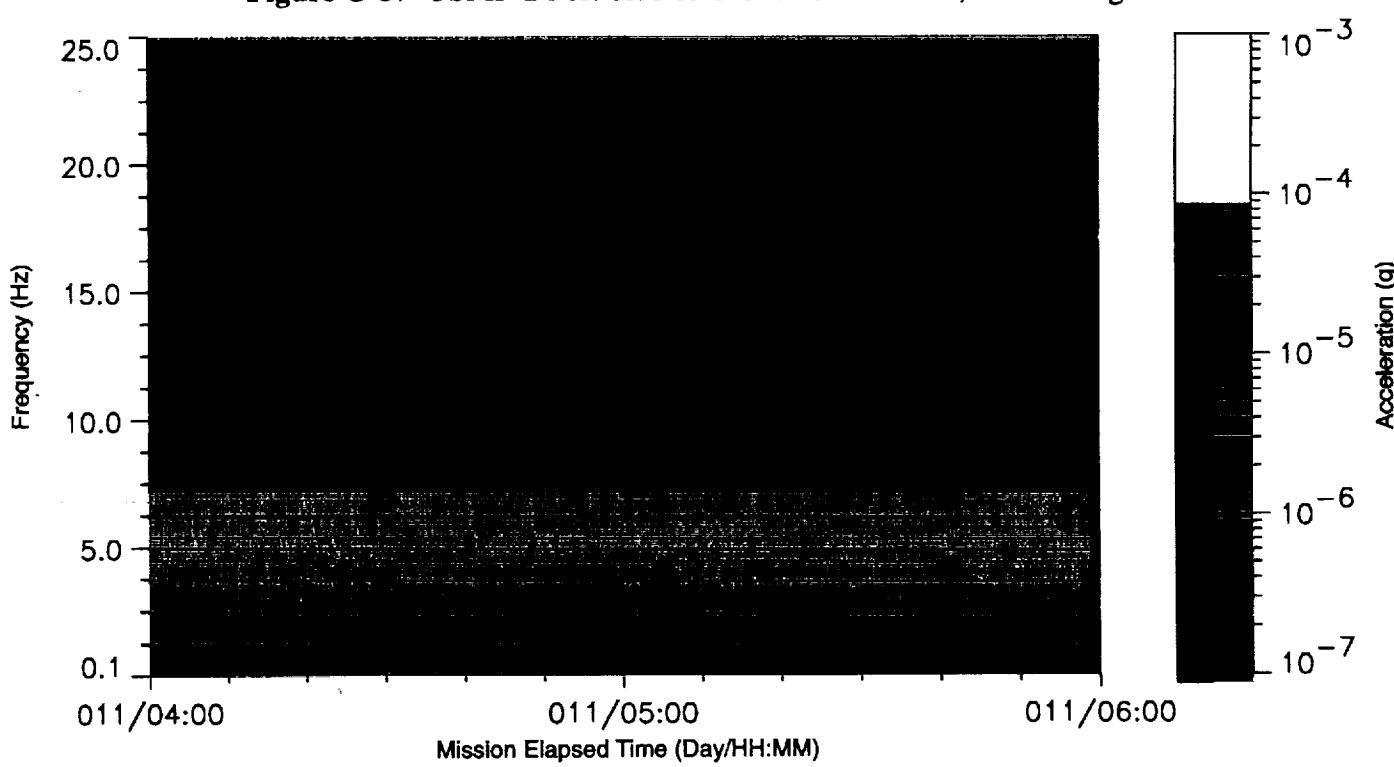
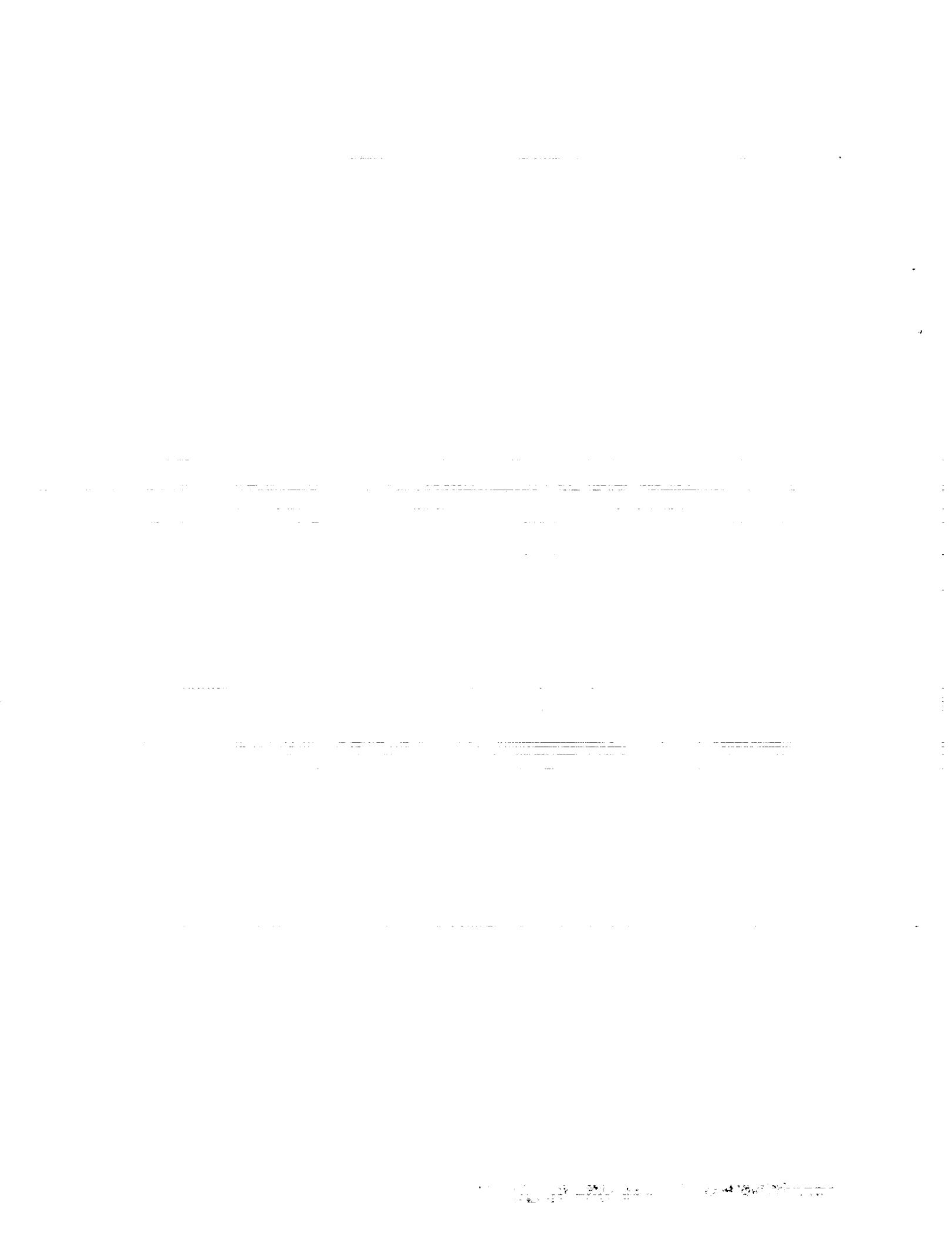


Figure C-87 USMP-2 Port Side of Orbiter Center Line, Vector Magnitude





SUMMARY REPORT OF MISSION ACCELERATION MEASUREMENTS FOR STS-62

Figure C-88 USMP-2 Port Side of Orbiter Center Line, Vector Magnitude

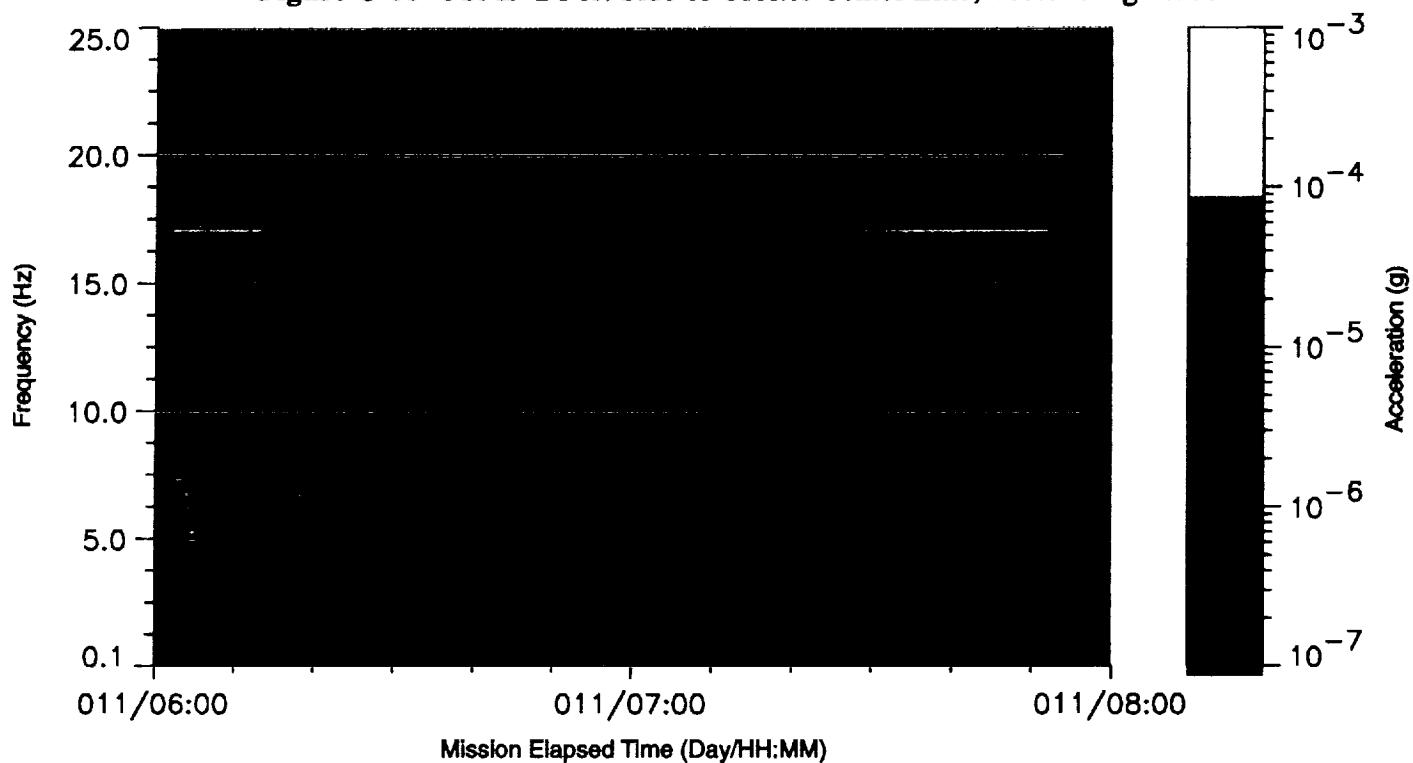
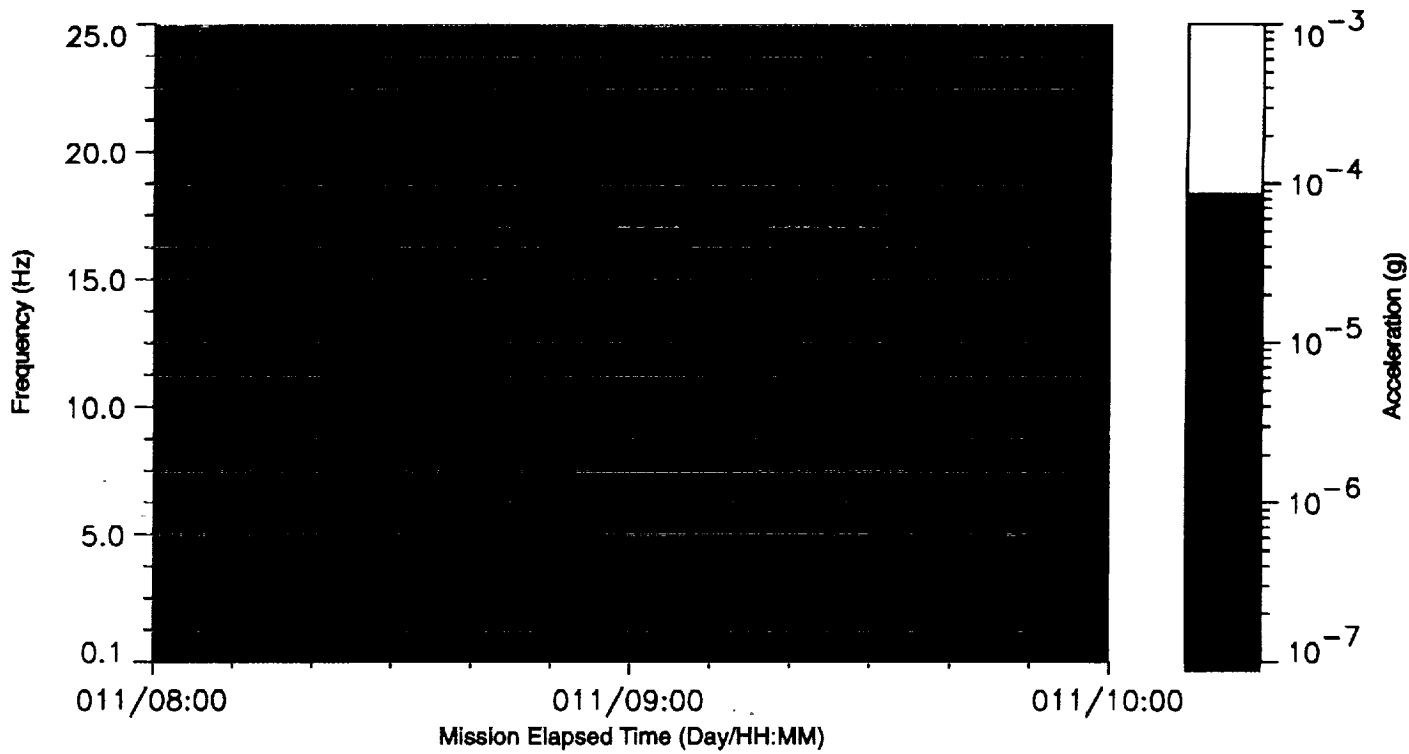
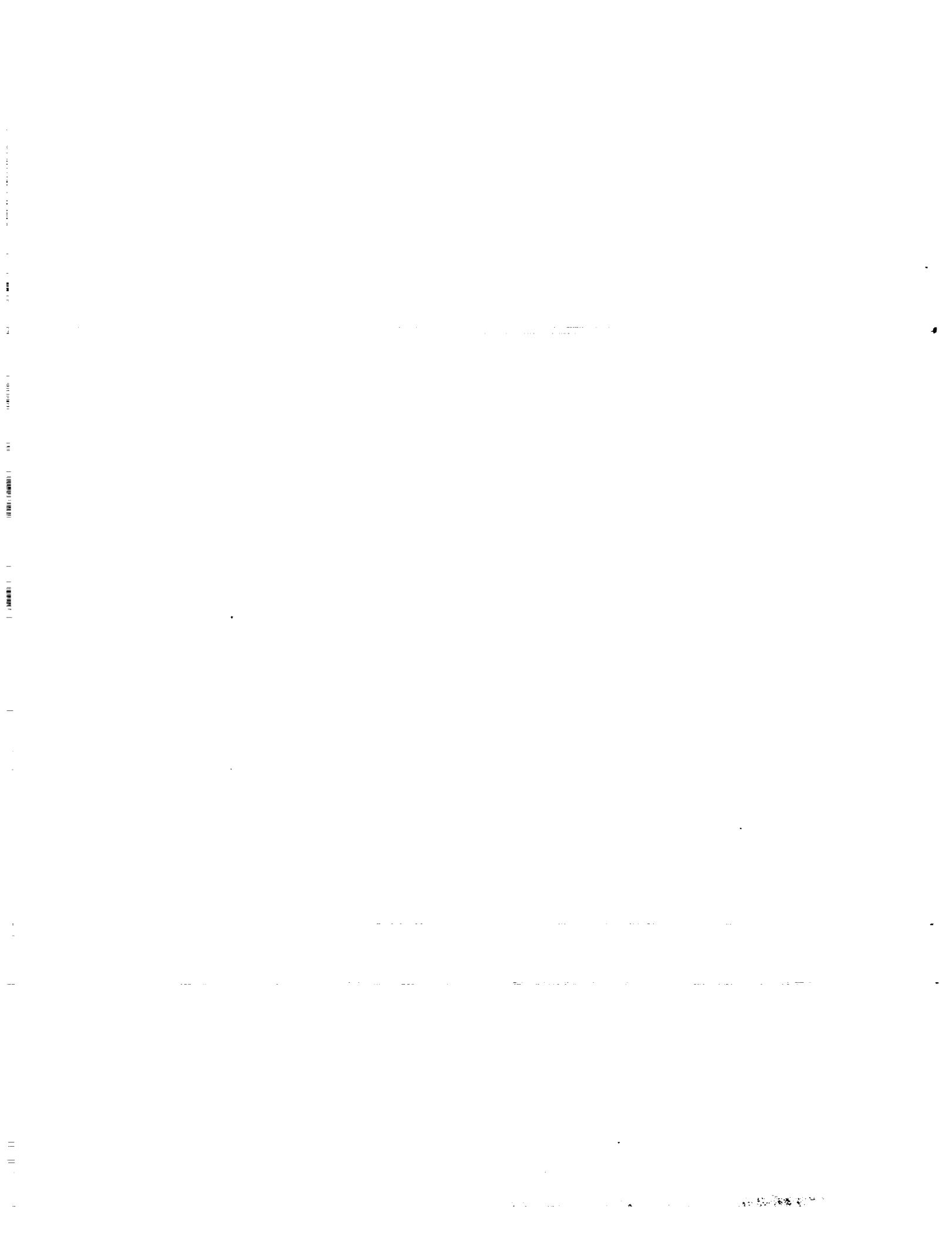


Figure C-89 USMP-2 Port Side of Orbiter Center Line, Vector Magnitude





SUMMARY REPORT OF MISSION ACCELERATION MEASUREMENTS FOR STS-62

Figure C-90 USMP-2 Port Side of Orbiter Center Line, Vector Magnitude

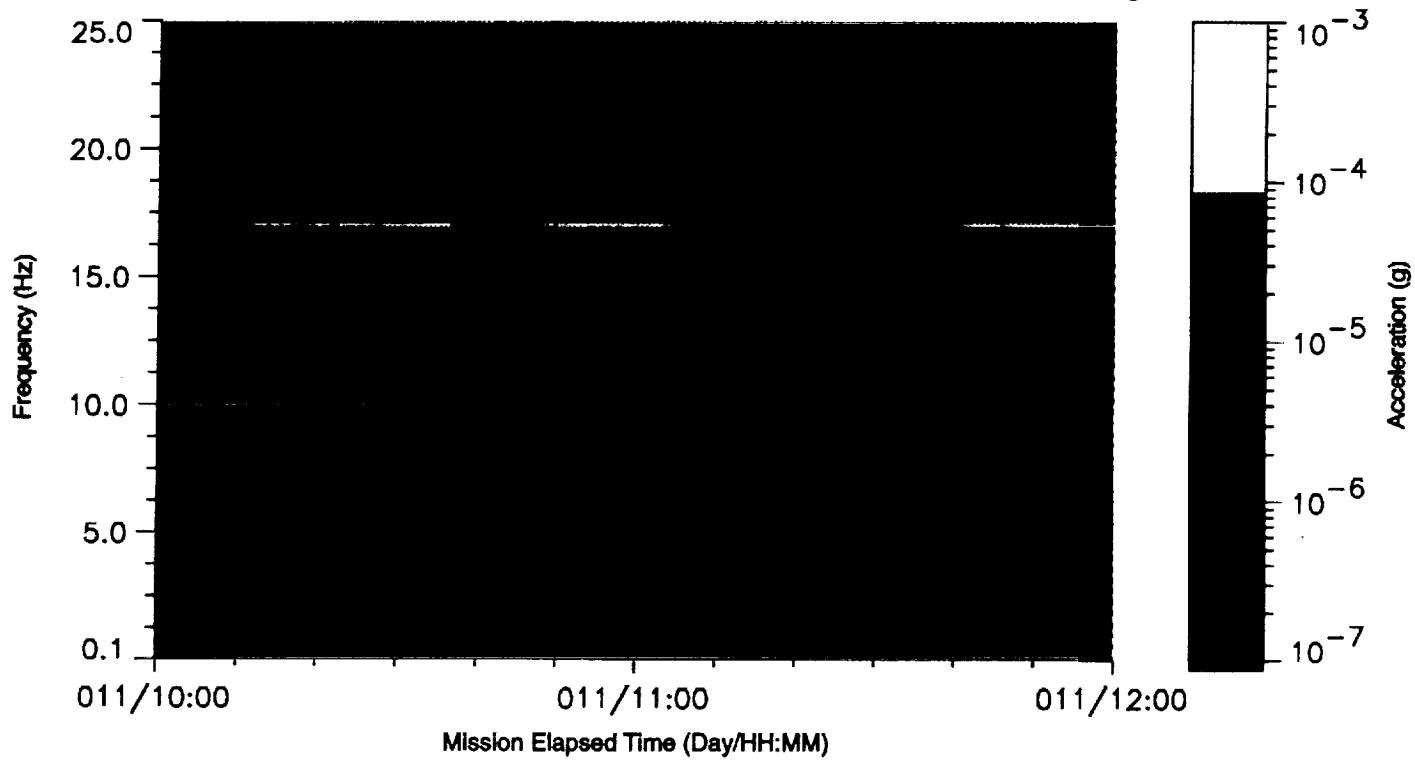
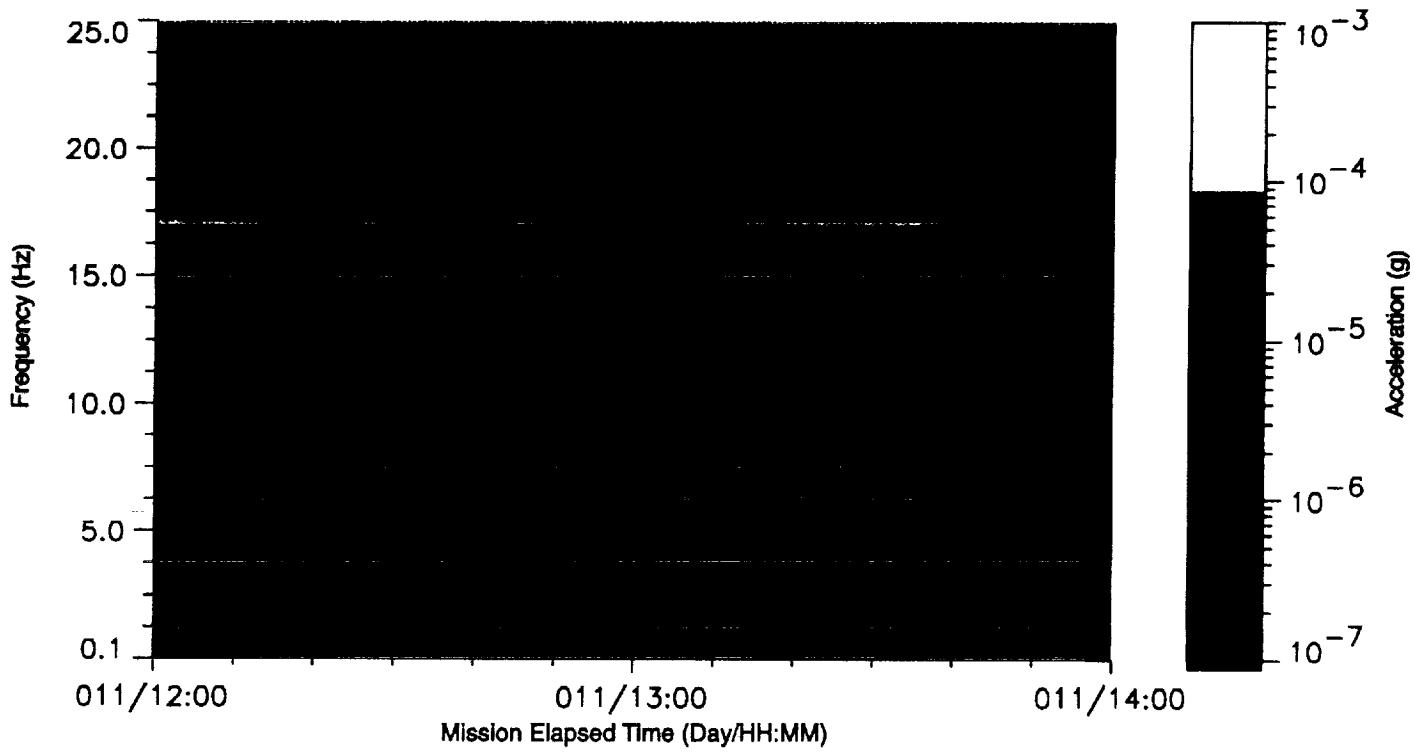


Figure C-91 USMP-2 Port Side of Orbiter Center Line, Vector Magnitude



SUMMARY REPORT OF MISSION ACCELERATION MEASUREMENTS FOR STS-62

Figure C-92 USMP-2 Port Side of Orbiter Center Line, Vector Magnitude

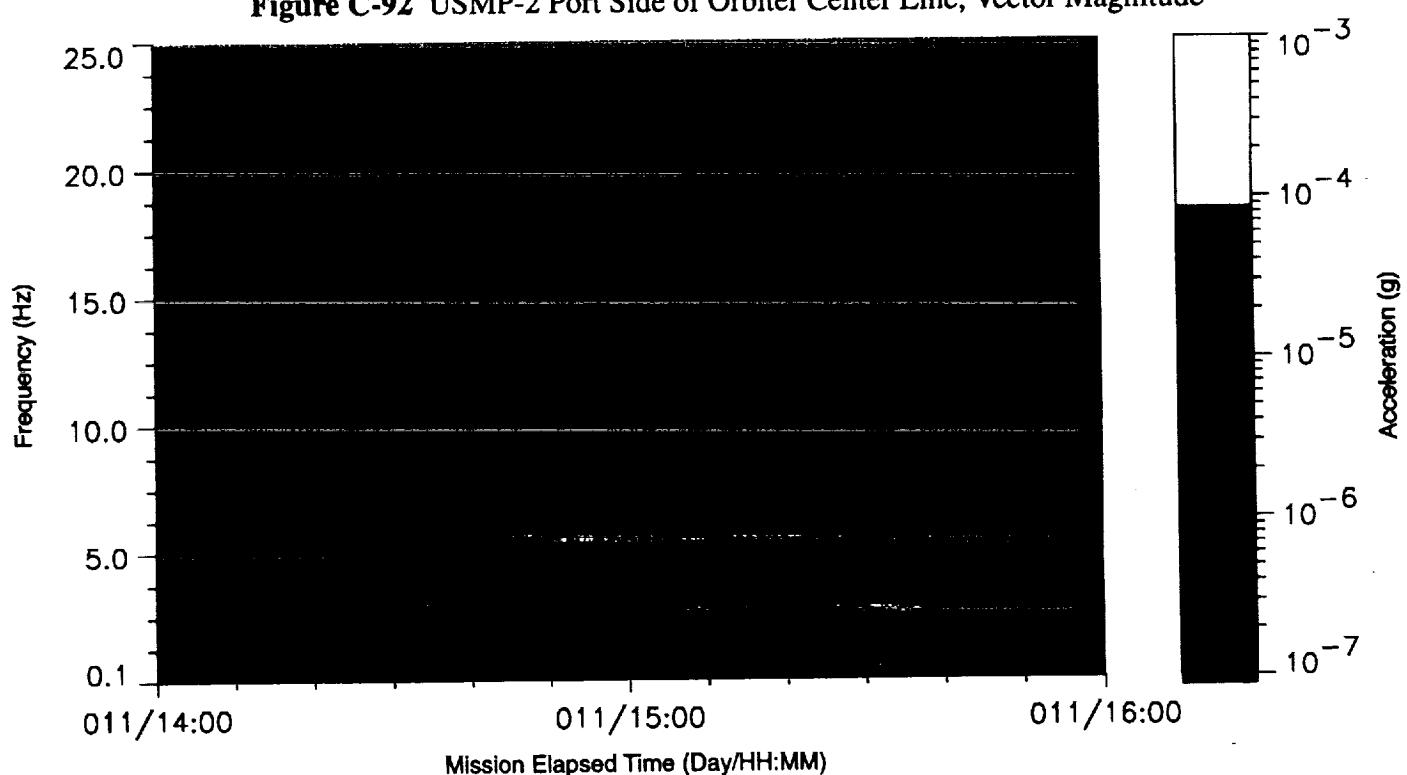
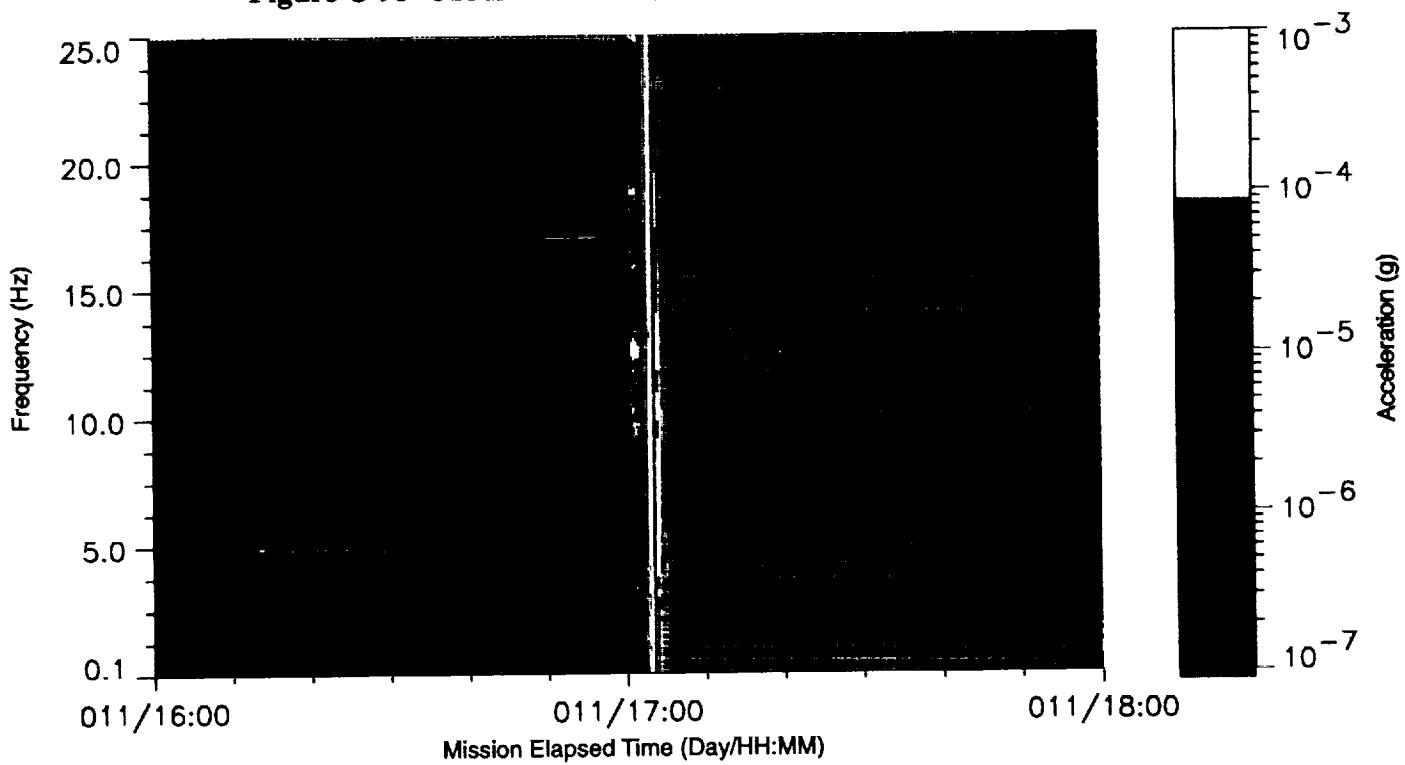


Figure C-93 USMP-2 Port Side of Orbiter Center Line, Vector Magnitude





SUMMARY REPORT OF MISSION ACCELERATION MEASUREMENTS FOR STS-62

Figure C-94 USMP-2 Port Side of Orbiter Center Line, Vector Magnitude

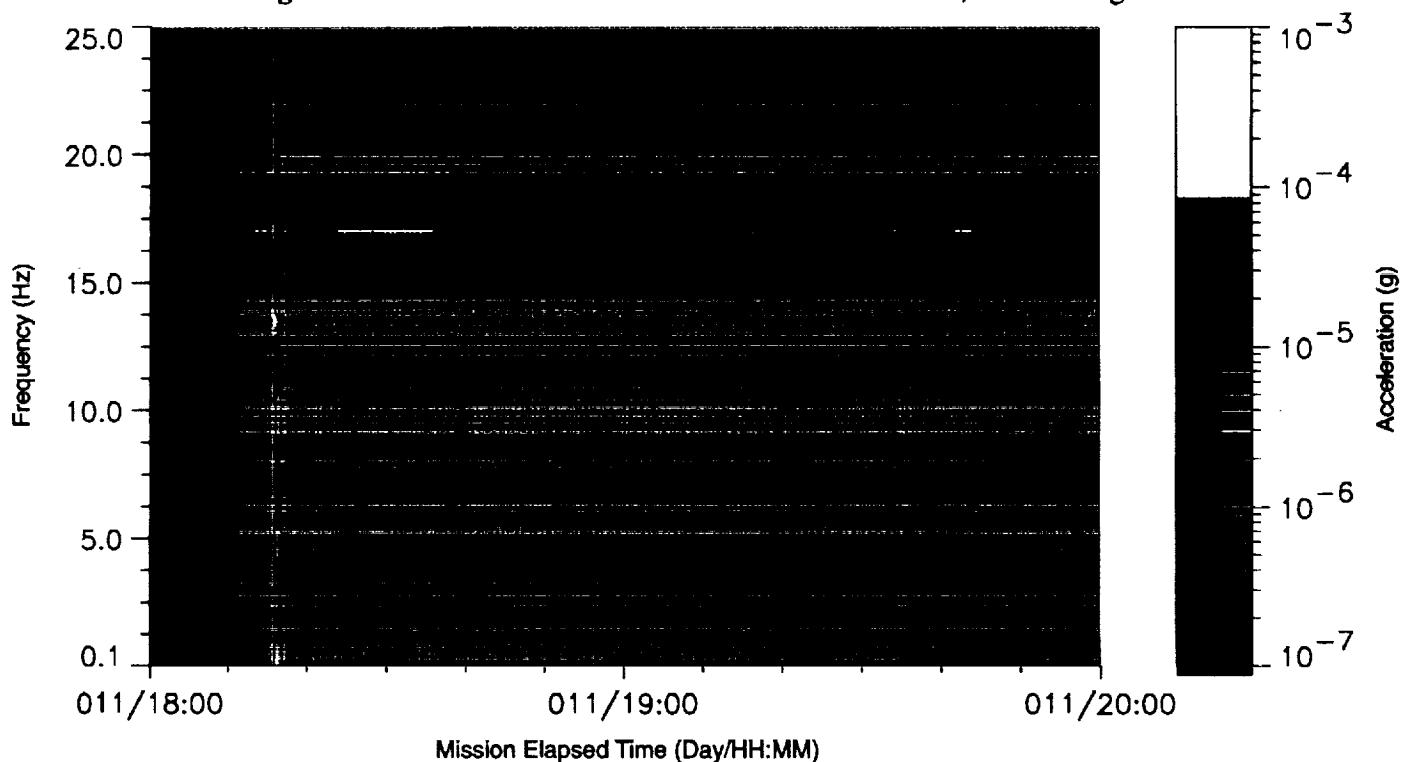
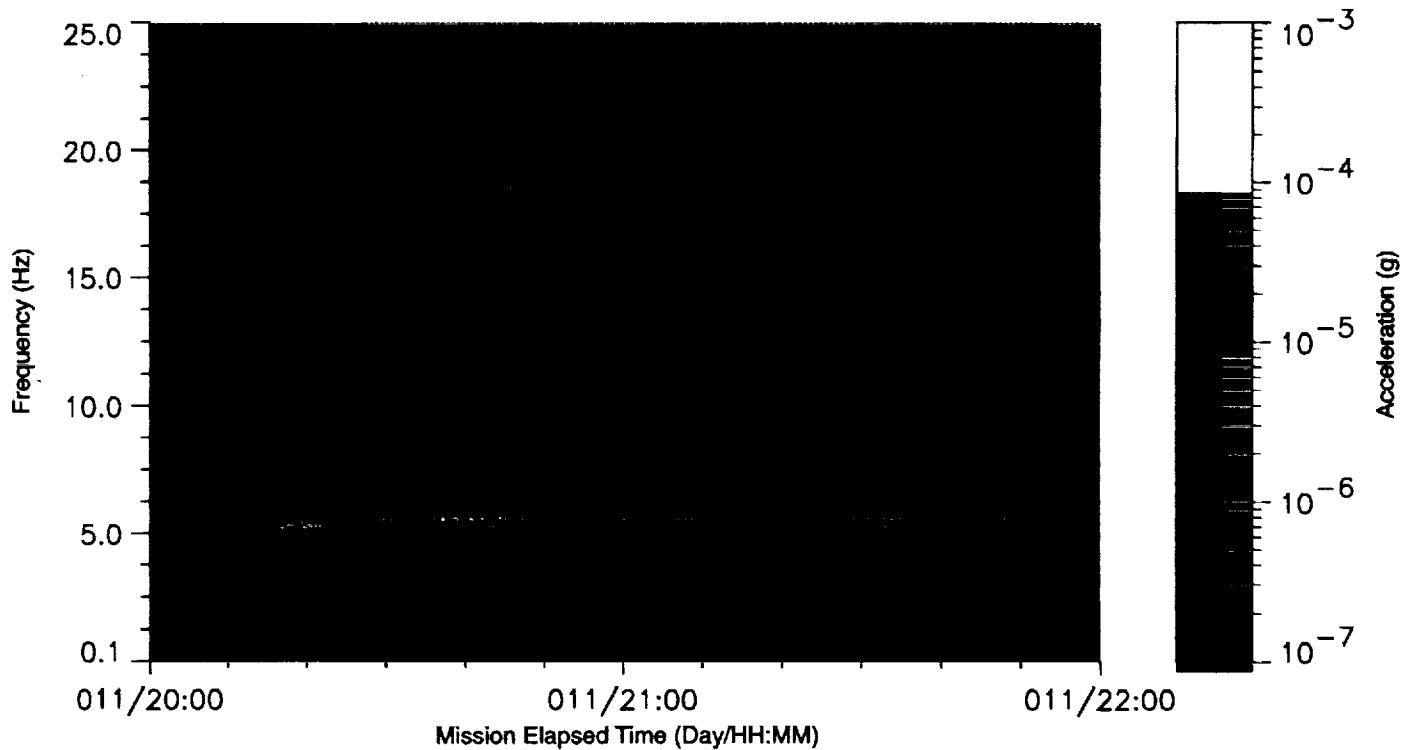


Figure C-95 USMP-2 Port Side of Orbiter Center Line, Vector Magnitude





SUMMARY REPORT OF MISSION ACCELERATION MEASUREMENTS FOR STS-62

Figure C-96 USMP-2 Port Side of Orbiter Center Line, Vector Magnitude

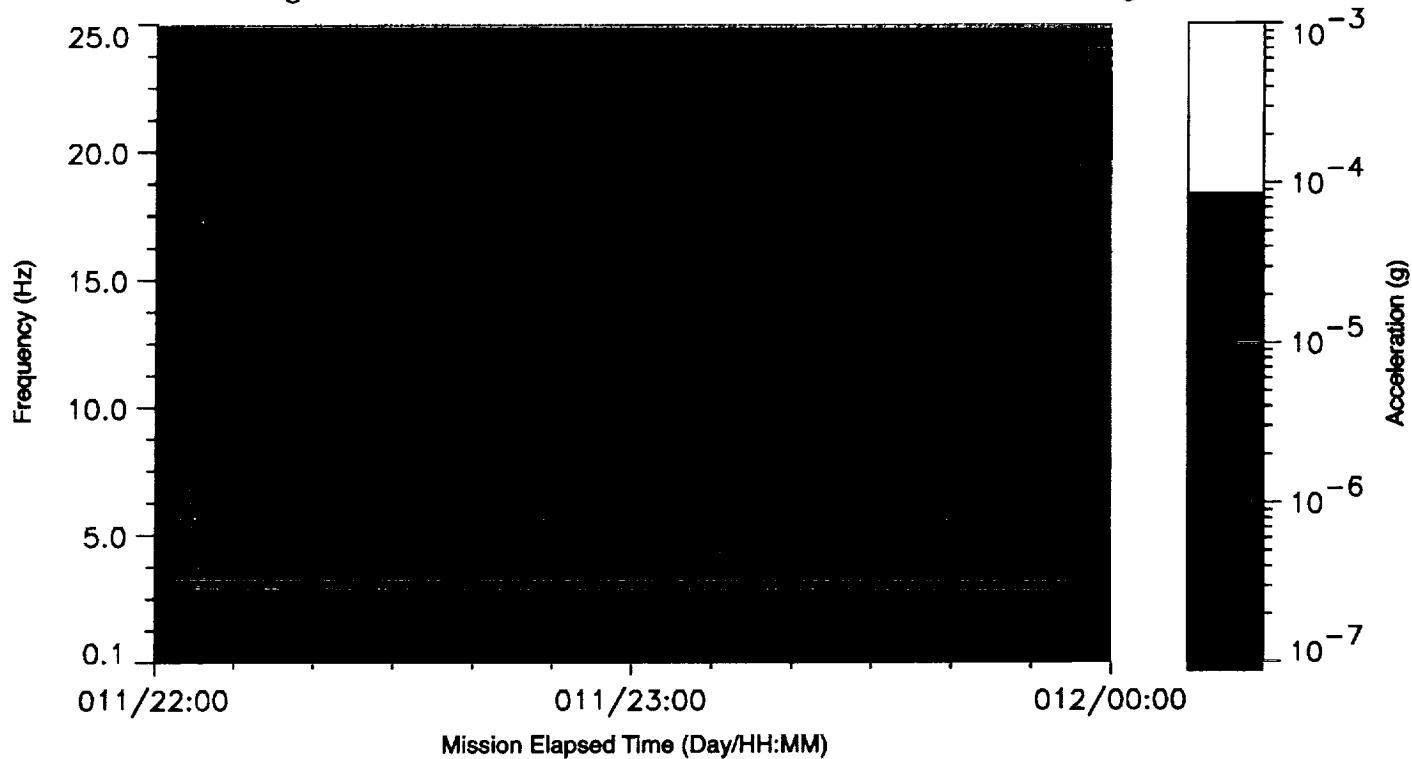
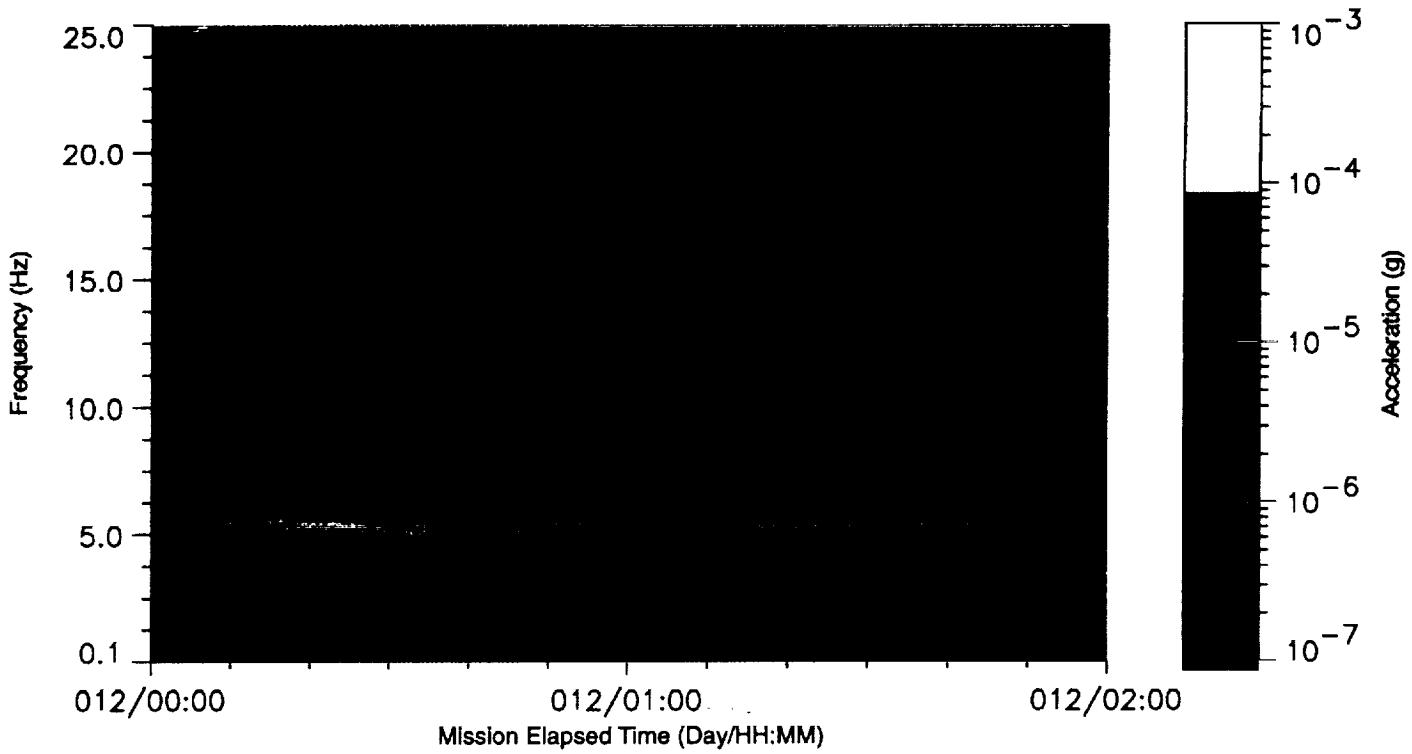


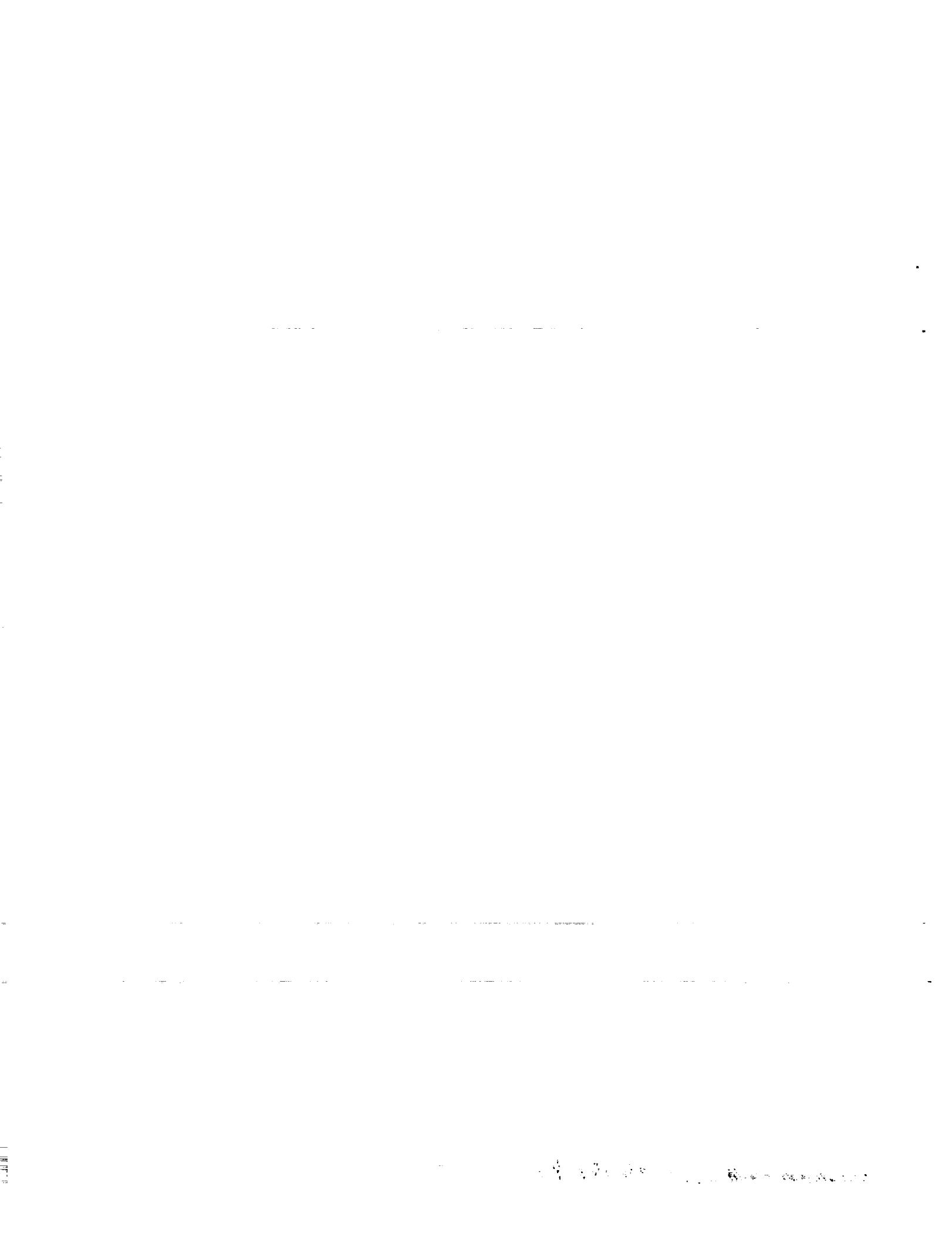
Figure C-97 USMP-2 Port Side of Orbiter Center Line, Vector Magnitude



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SUMMARY REPORT OF MISSION ACCELERATION MEASUREMENTS FOR STS-62

Figure C-98 USMP-2 Port Side of Orbiter Center Line, Vector Magnitude

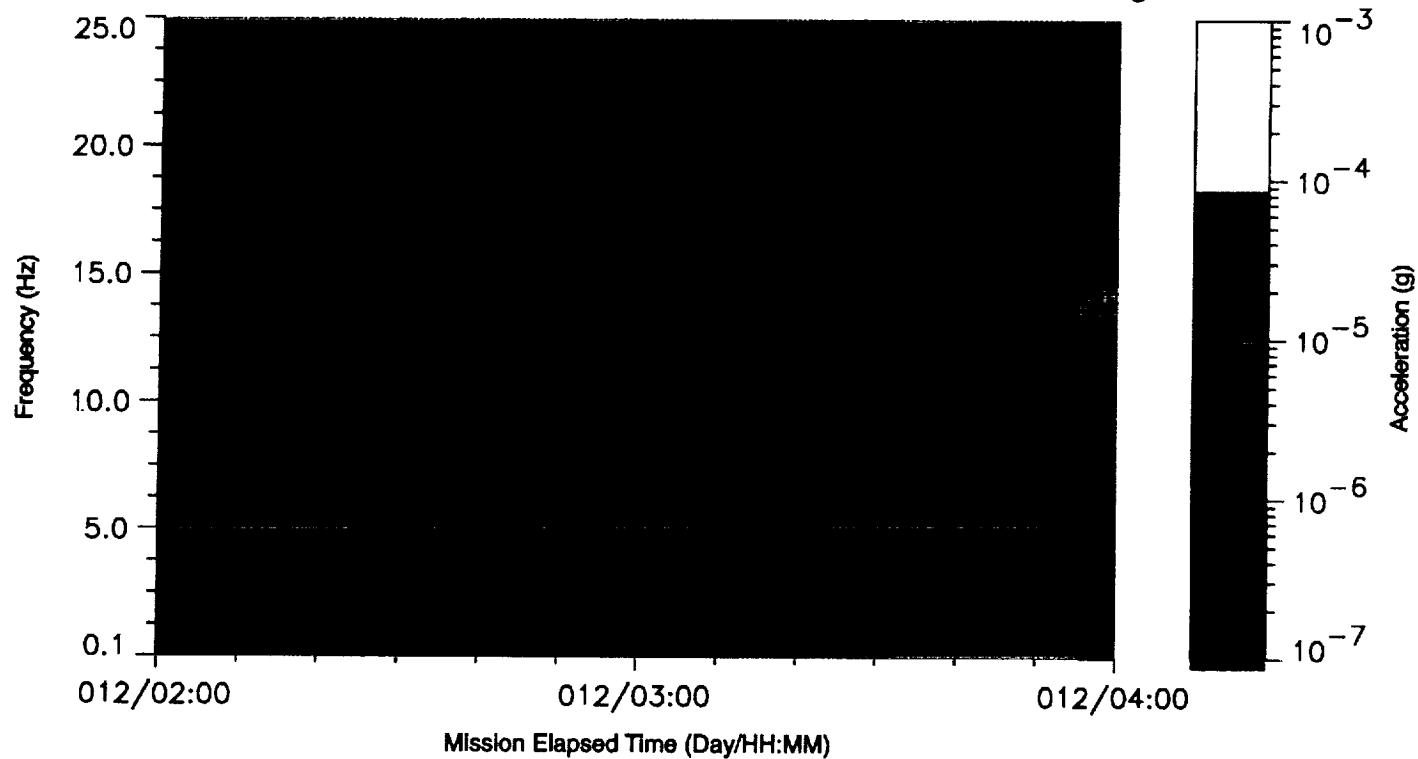
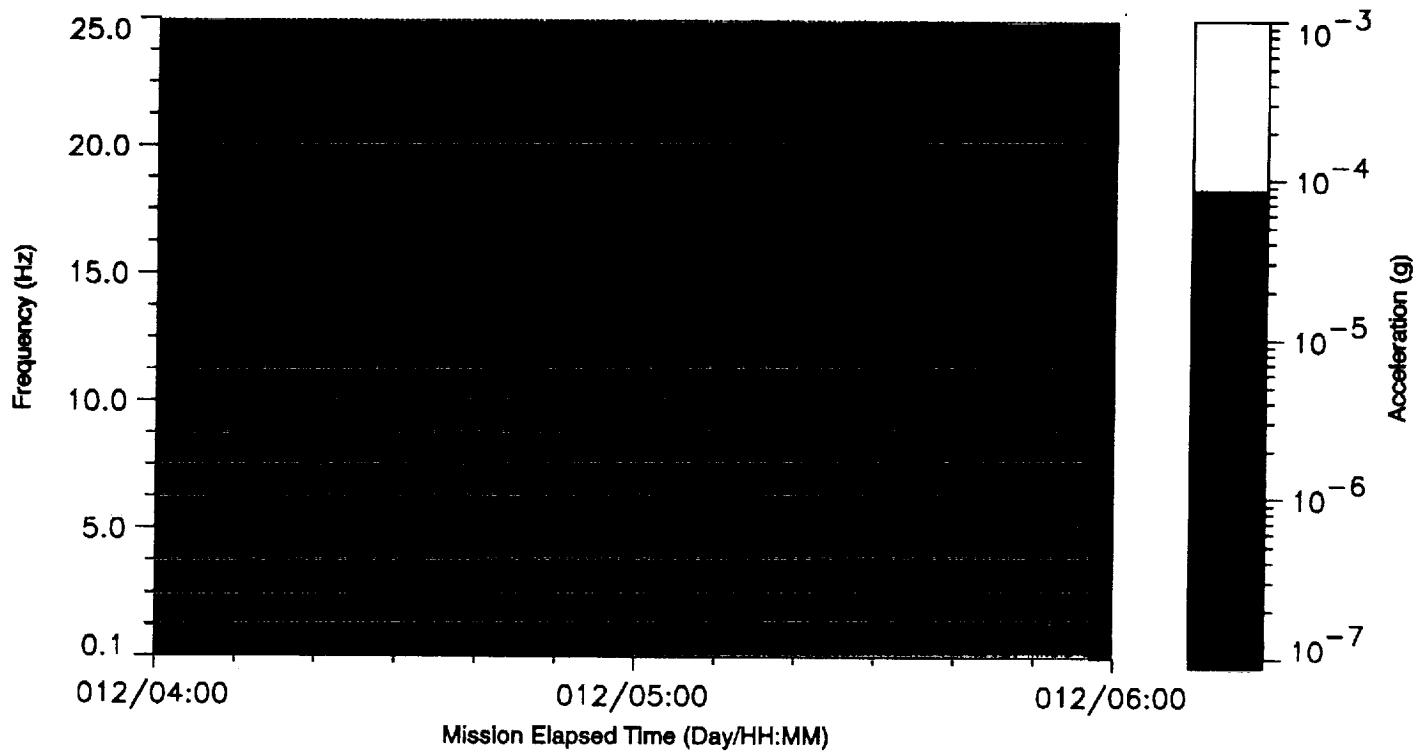
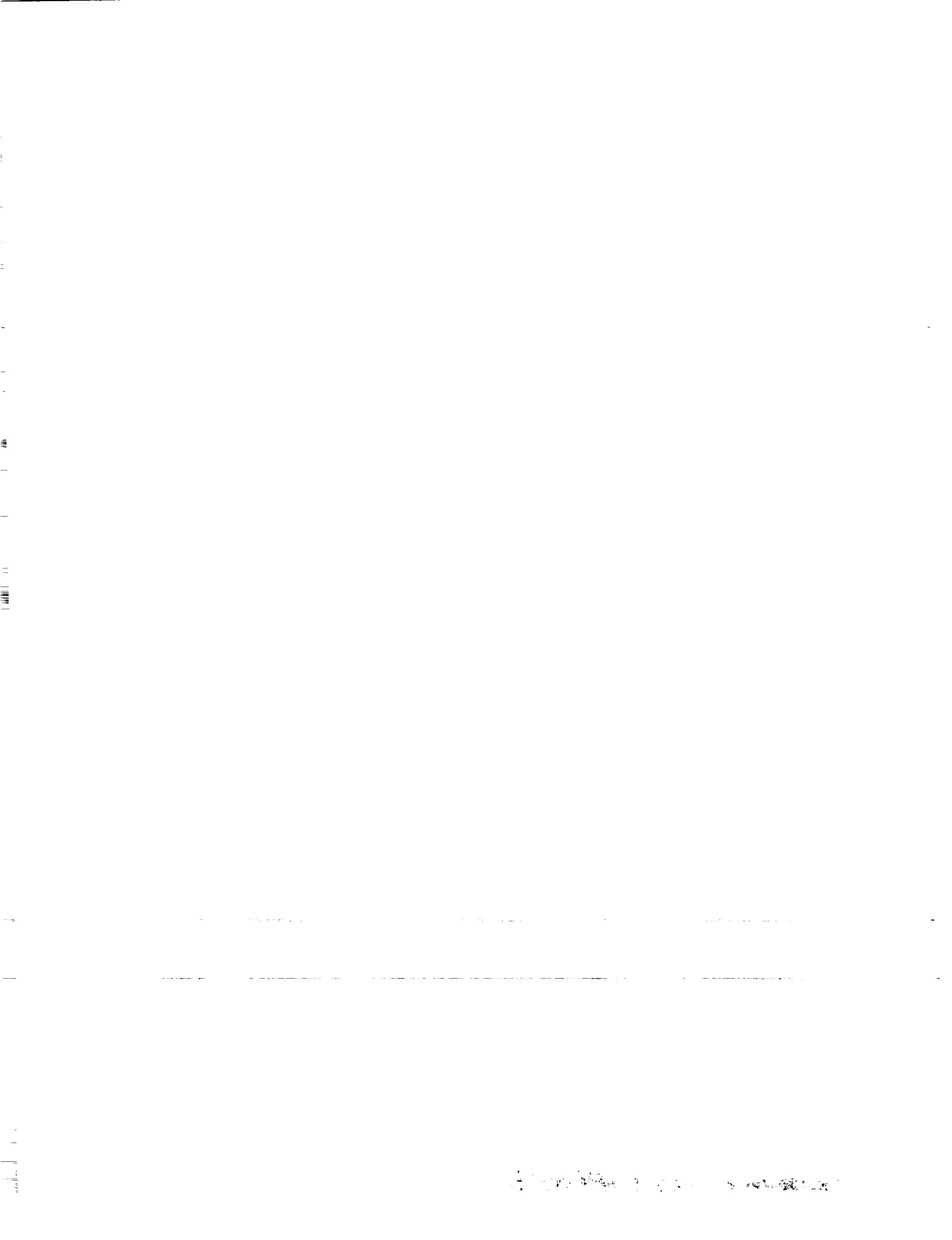


Figure C-99 USMP-2 Port Side of Orbiter Center Line, Vector Magnitude





SUMMARY REPORT OF MISSION ACCELERATION MEASUREMENTS FOR STS-62

Figure C-100 USMP-2 Port Side of Orbiter Center Line, Vector Magnitude

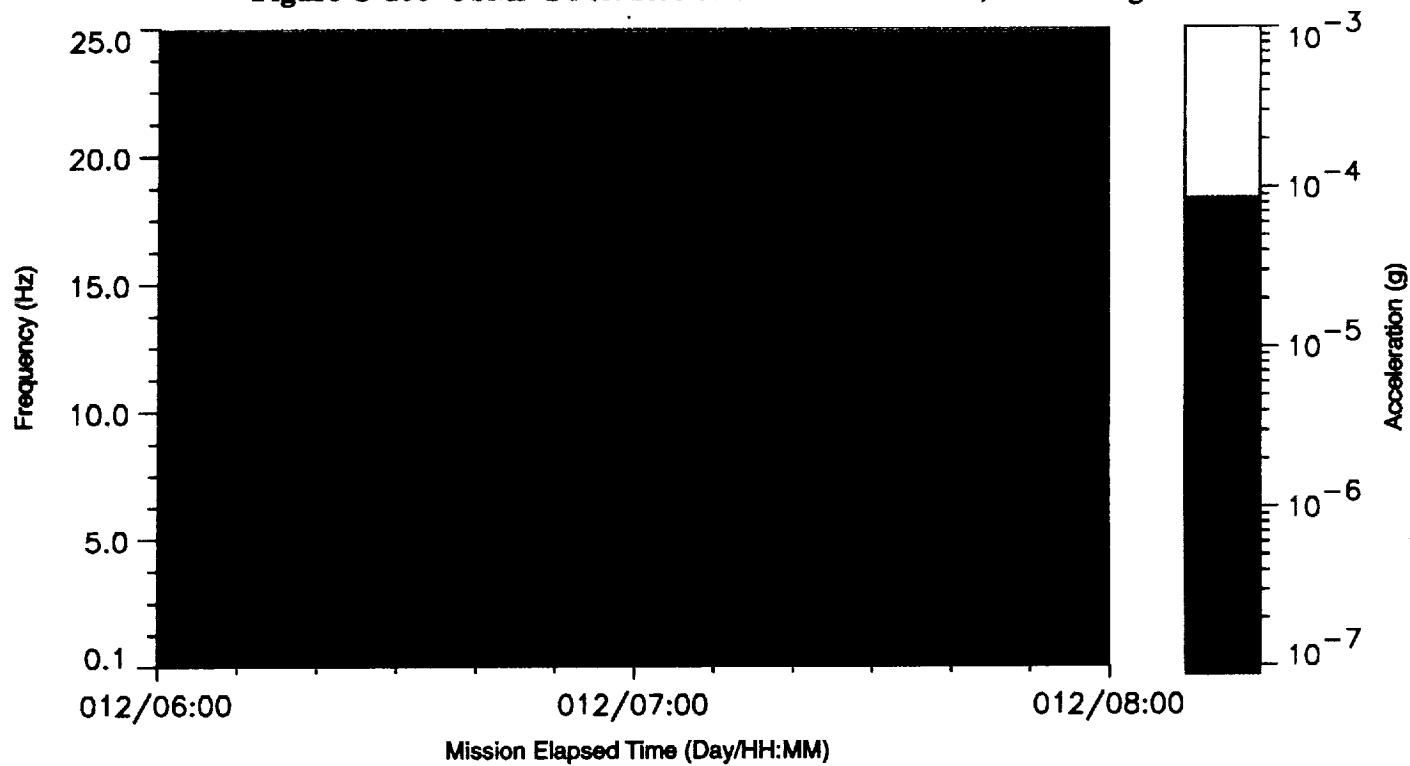
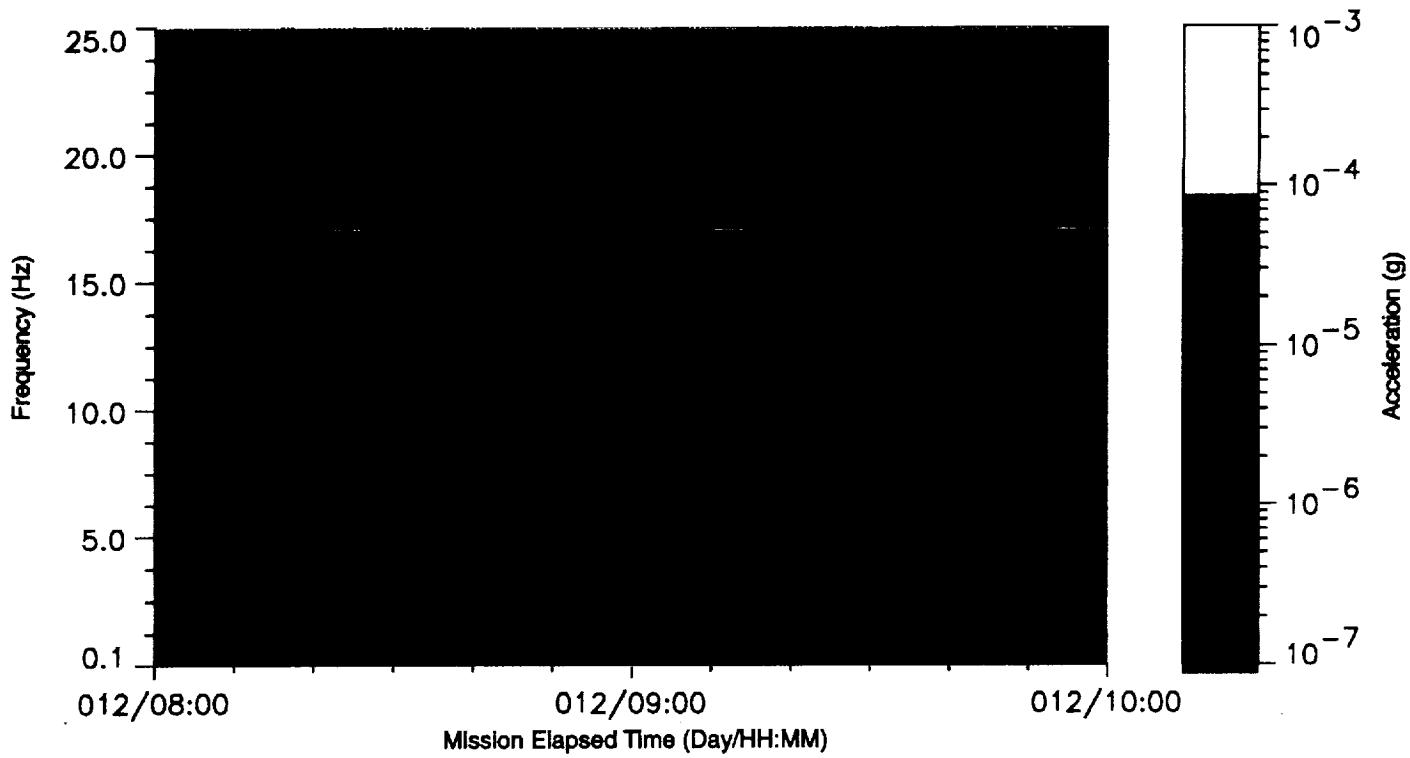
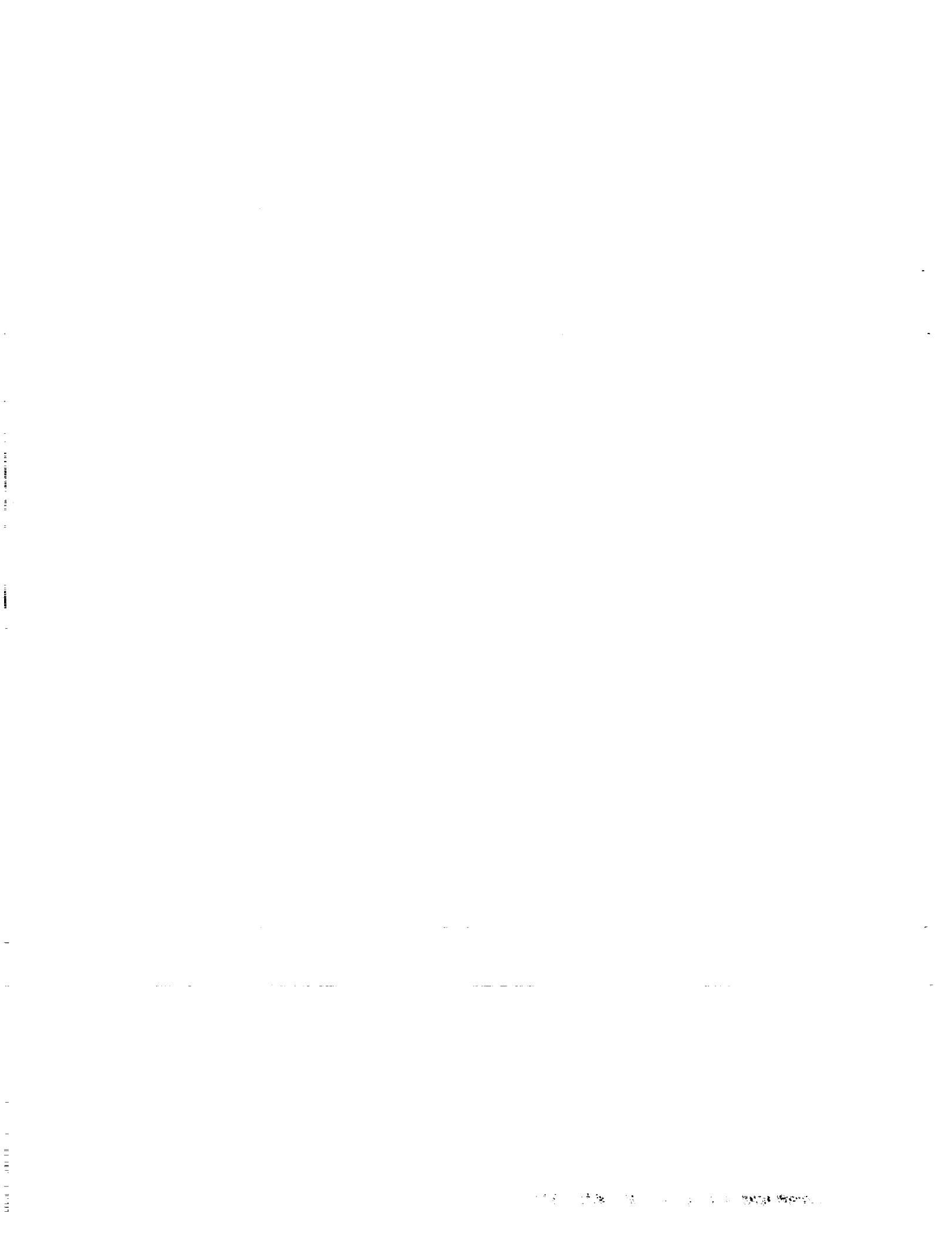


Figure C-101 USMP-2 Port Side of Orbiter Center Line, Vector Magnitude





SUMMARY REPORT OF MISSION ACCELERATION MEASUREMENTS FOR STS-62

Figure C-102 USMP-2 Port Side of Orbiter Center Line, Vector Magnitude

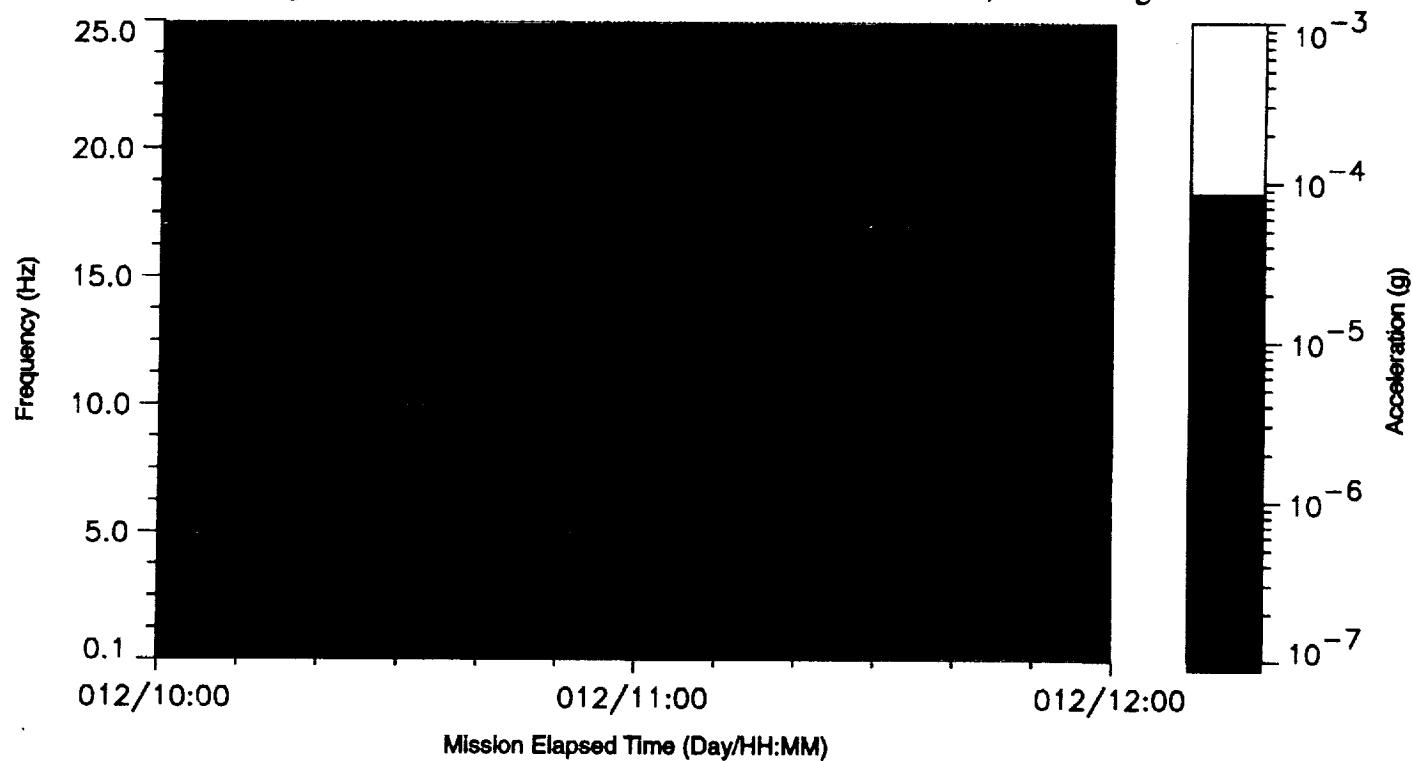
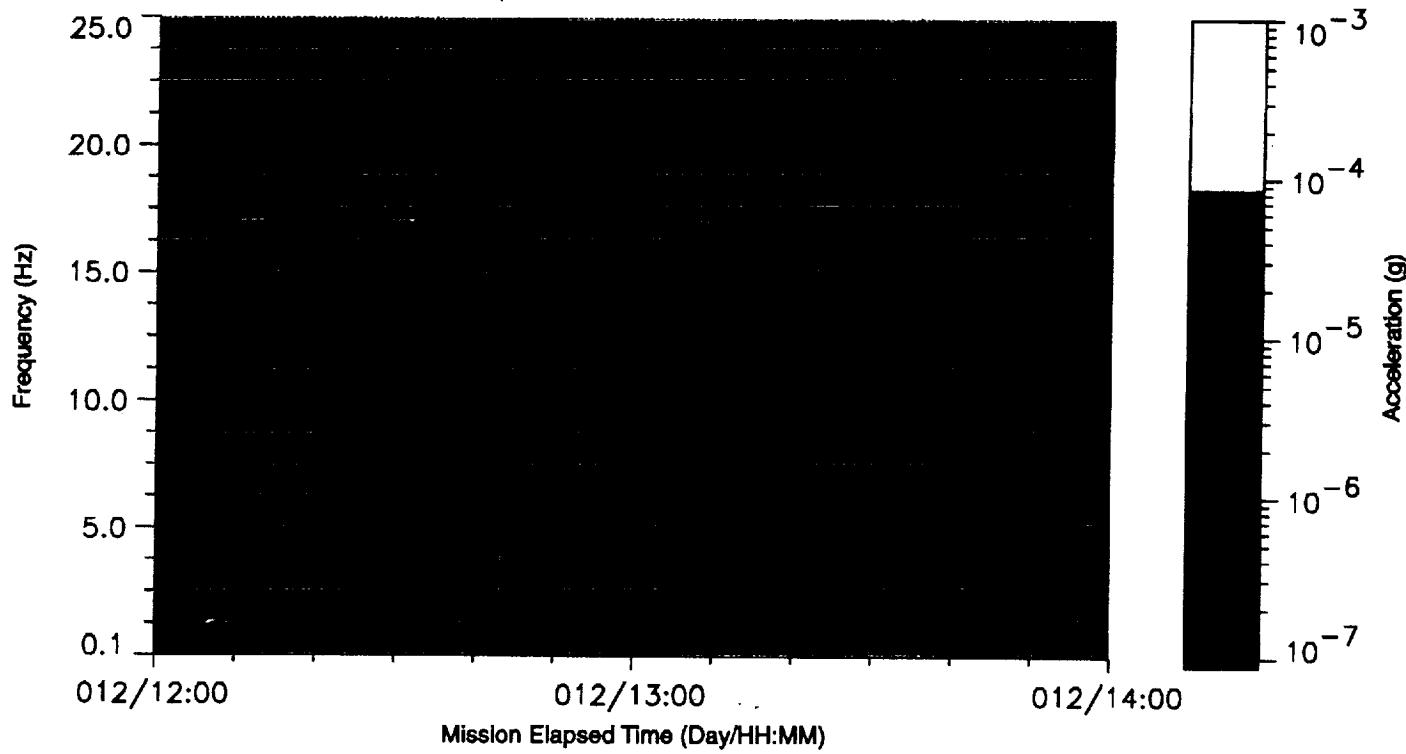
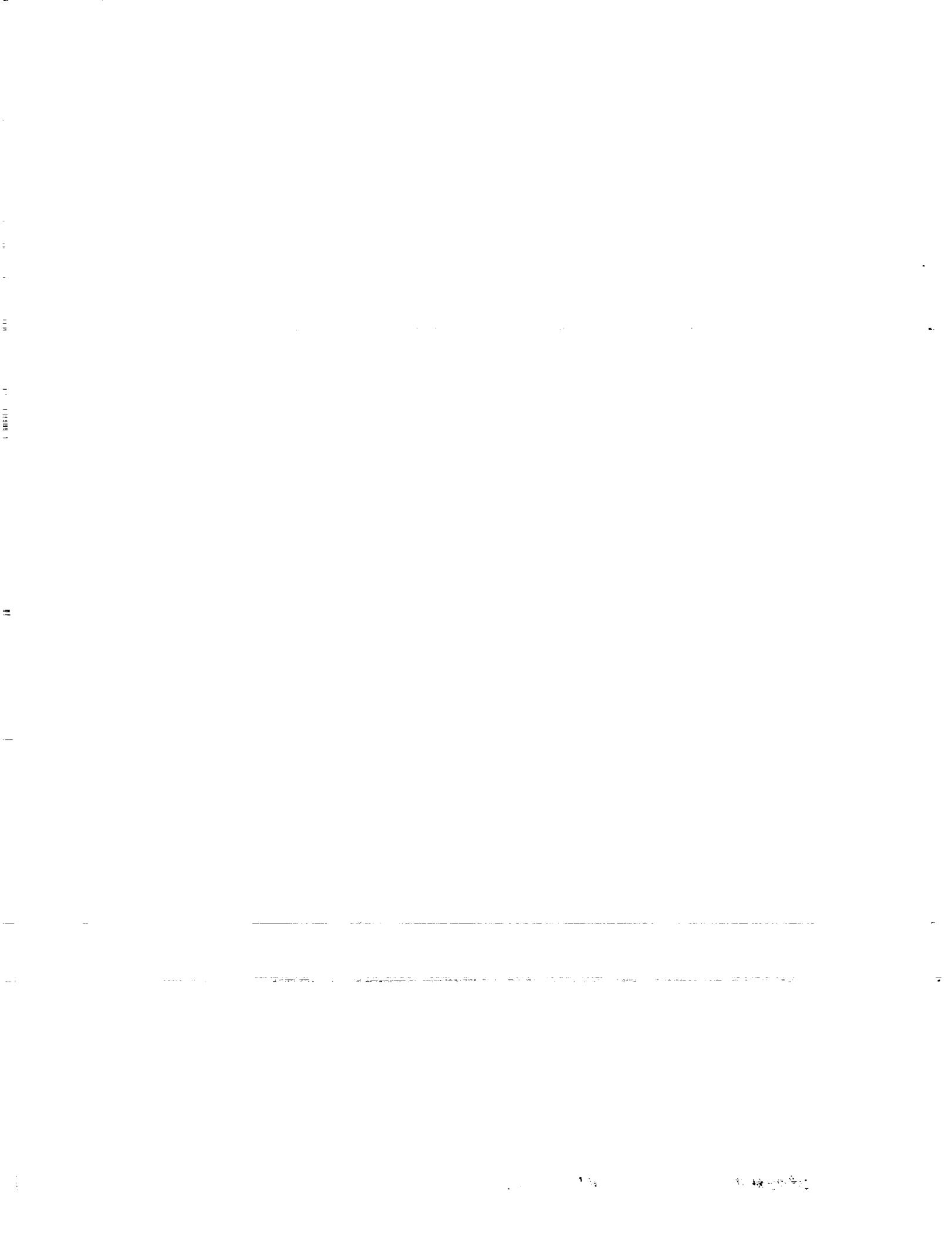


Figure C-103 USMP-2 Port Side of Orbiter Center Line, Vector Magnitude





SUMMARY REPORT OF MISSION ACCELERATION MEASUREMENTS FOR STS-62

Figure C-104 USMP-2 Port Side of Orbiter Center Line, Vector Magnitude

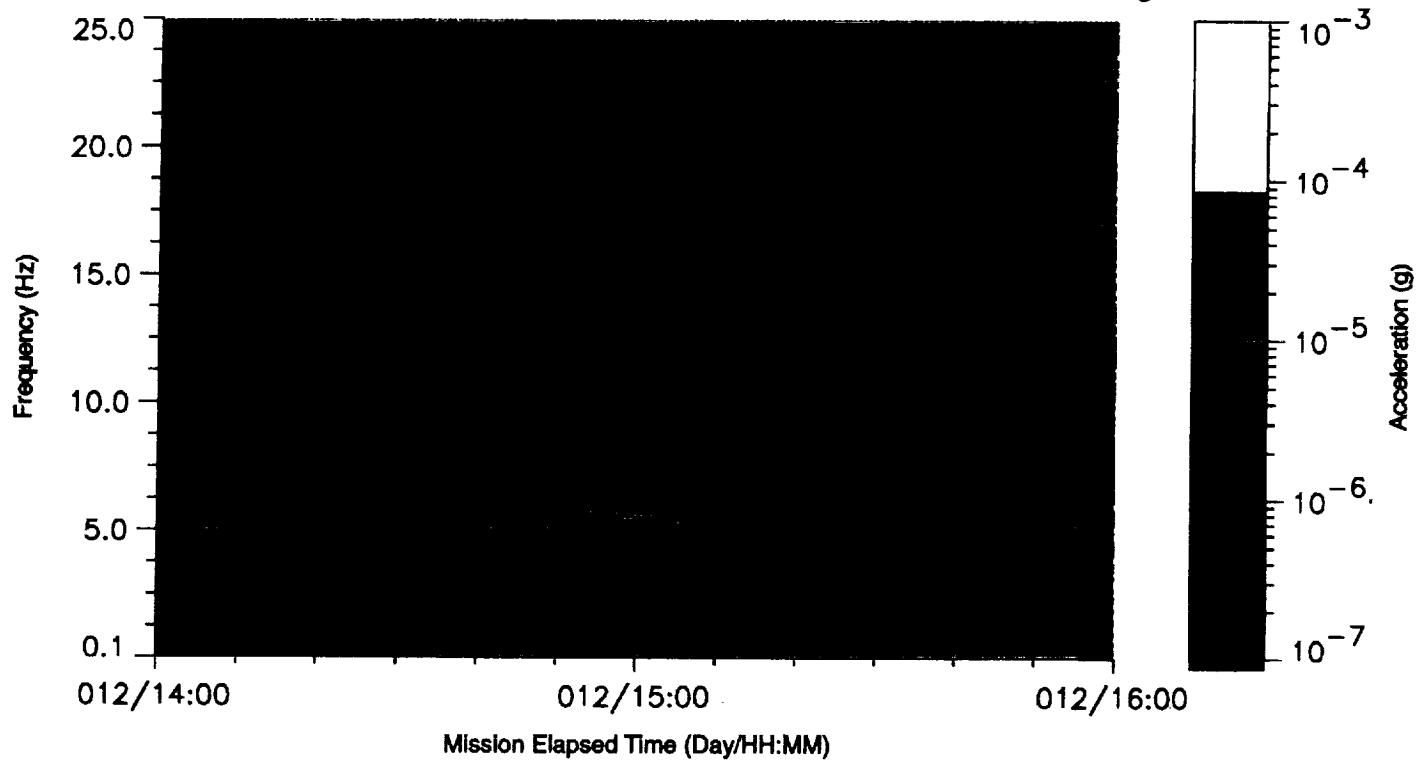
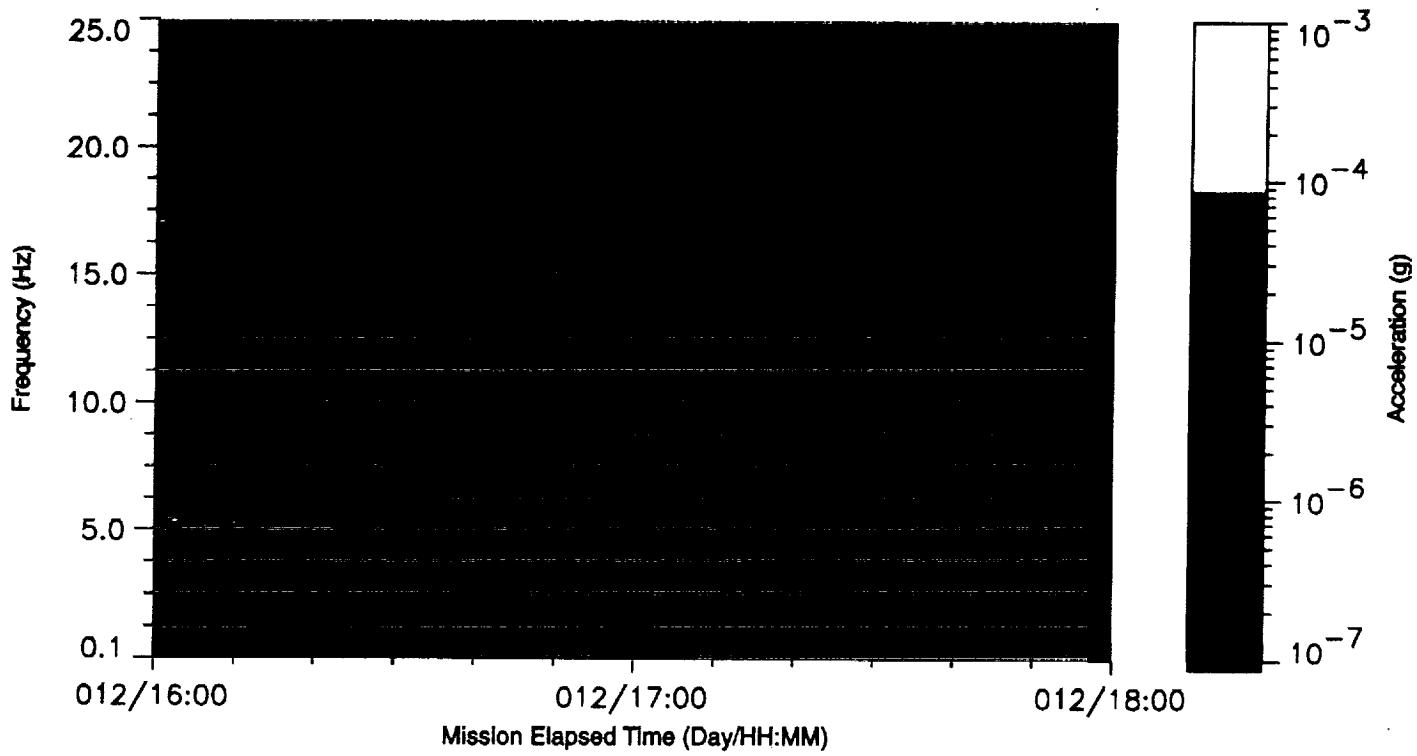
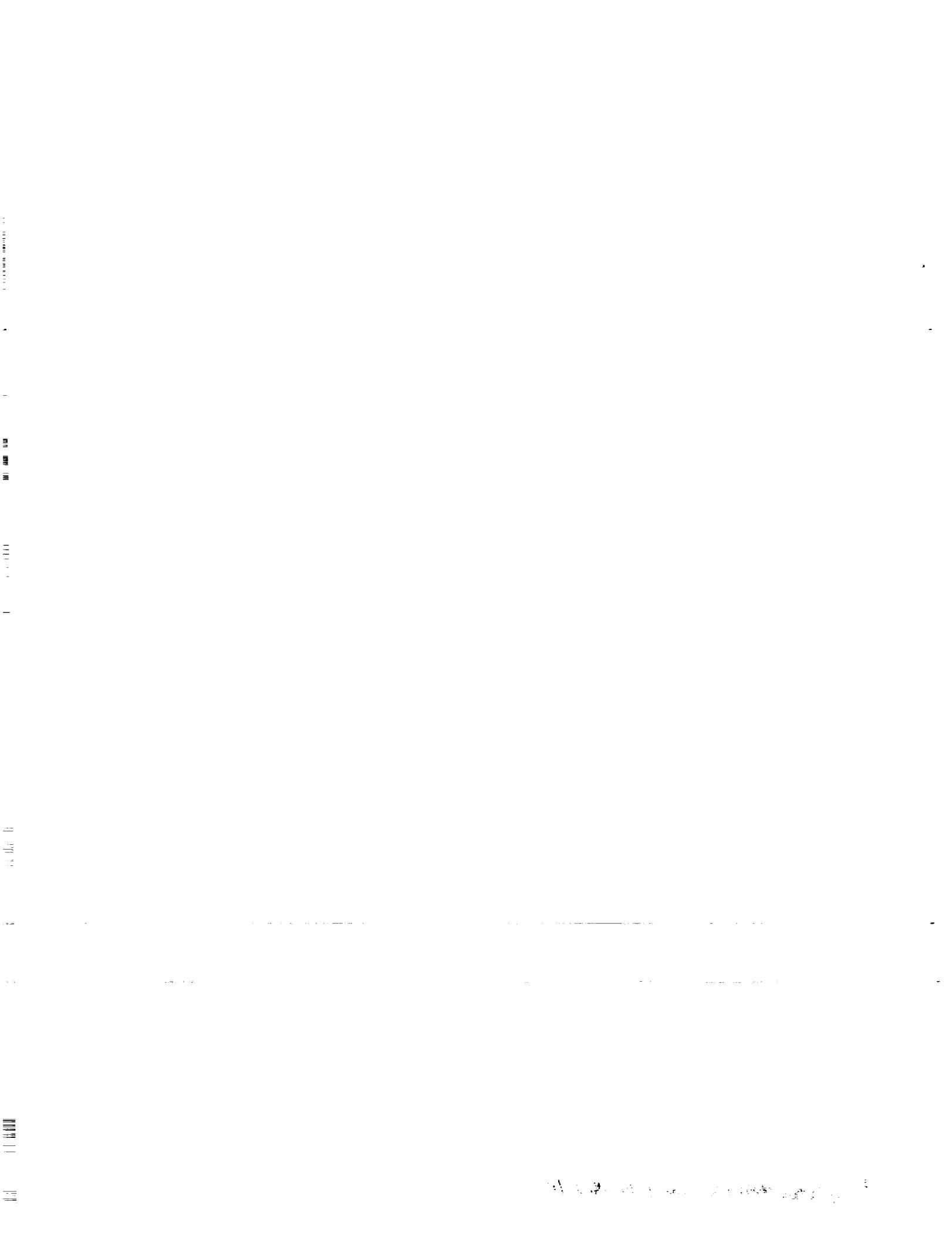


Figure C-105 USMP-2 Port Side of Orbiter Center Line, Vector Magnitude





SUMMARY REPORT OF MISSION ACCELERATION MEASUREMENTS FOR STS-62

Figure C-106 USMP-2 Port Side of Orbiter Center Line, Vector Magnitude

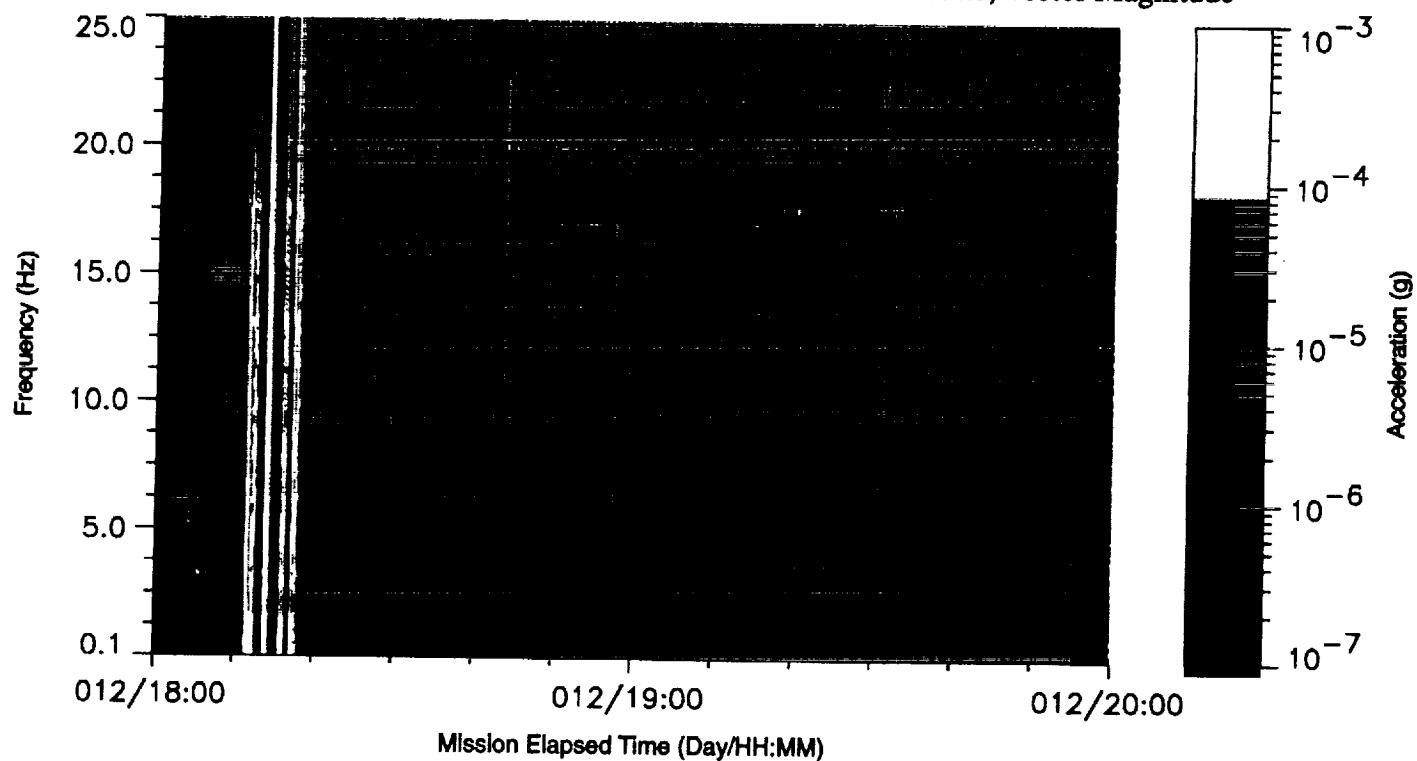
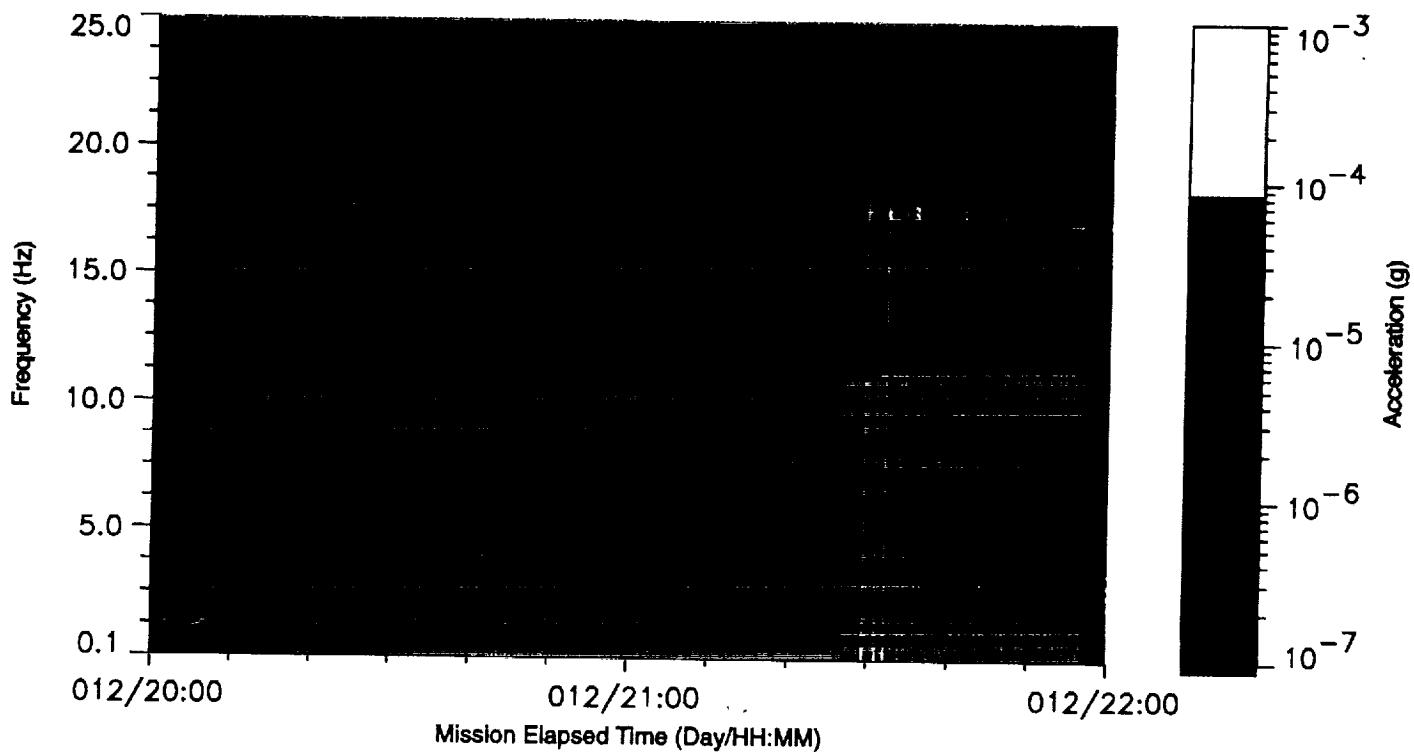
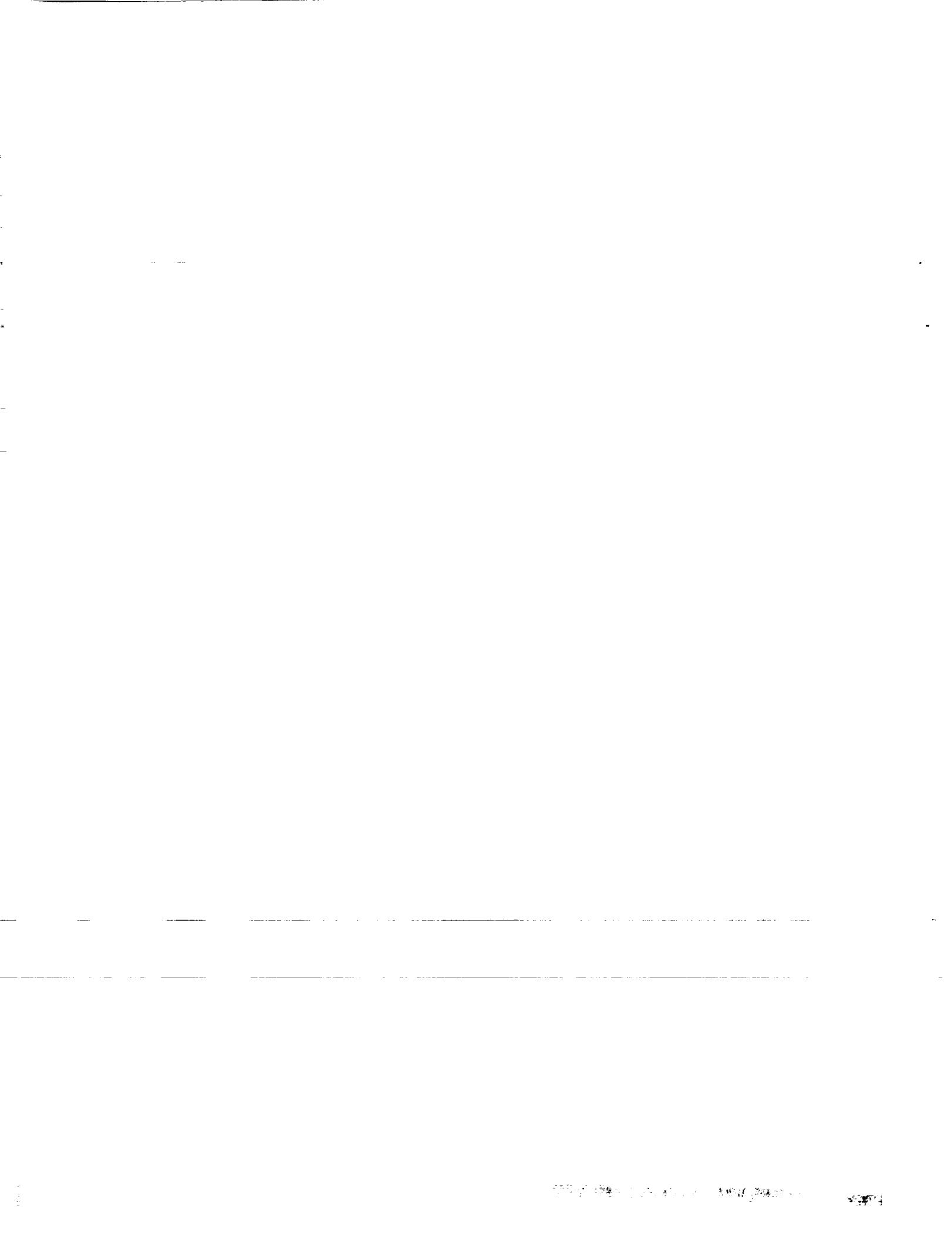


Figure C-107 USMP-2 Port Side of Orbiter Center Line, Vector Magnitude





SUMMARY REPORT OF MISSION ACCELERATION MEASUREMENTS FOR STS-62

Figure C-108 USMP-2 Port Side of Orbiter Center Line, Vector Magnitude

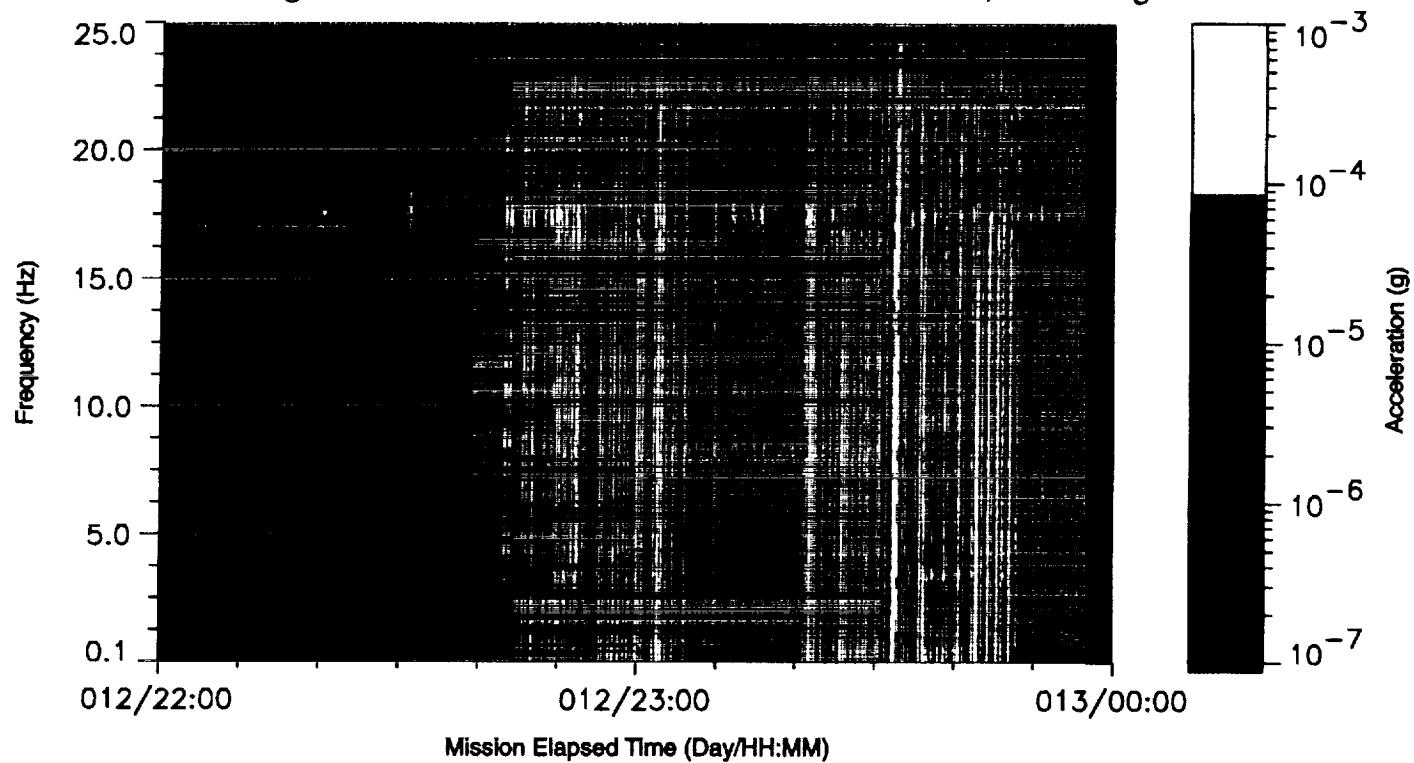
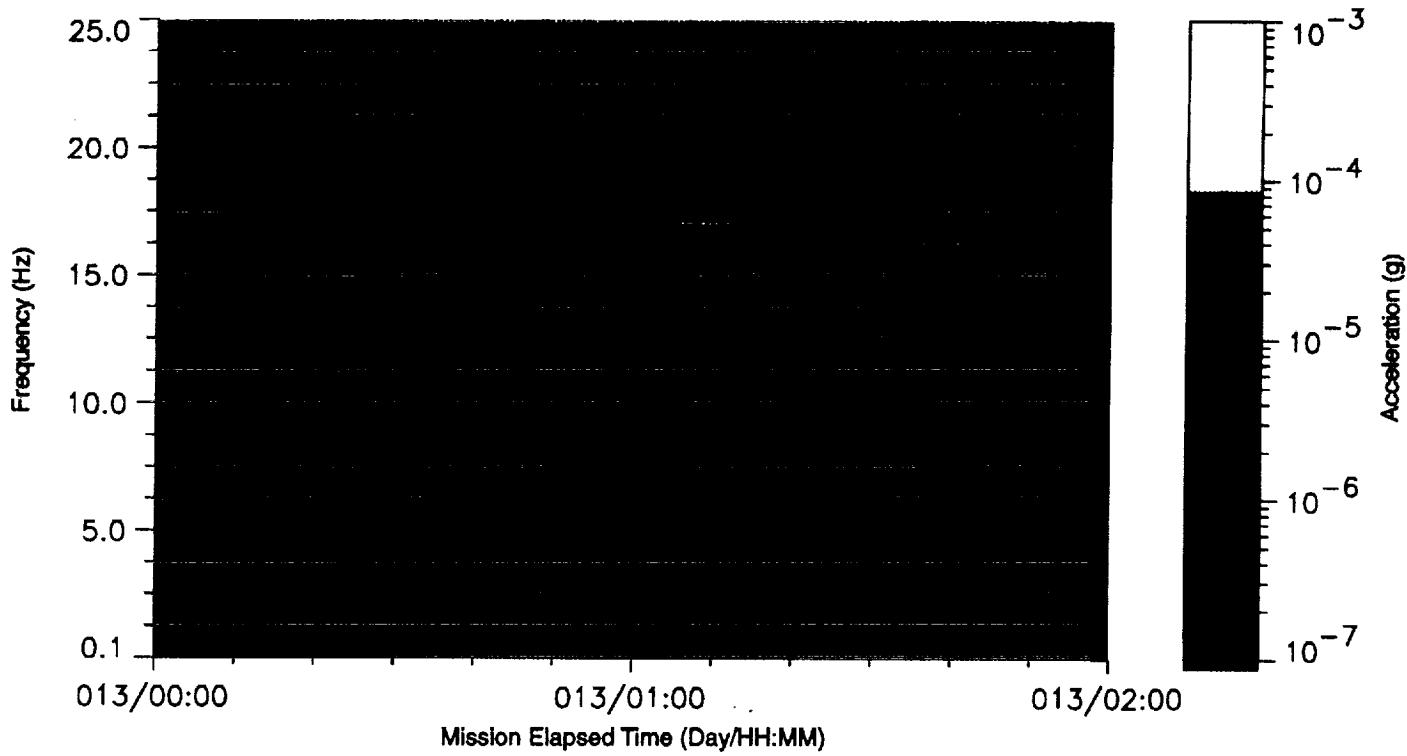


Figure C-109 USMP-2 Port Side of Orbiter Center Line, Vector Magnitude





SUMMARY REPORT OF MISSION ACCELERATION MEASUREMENTS FOR STS-62

Figure C-110 USMP-2 Port Side of Orbiter Center Line, Vector Magnitude

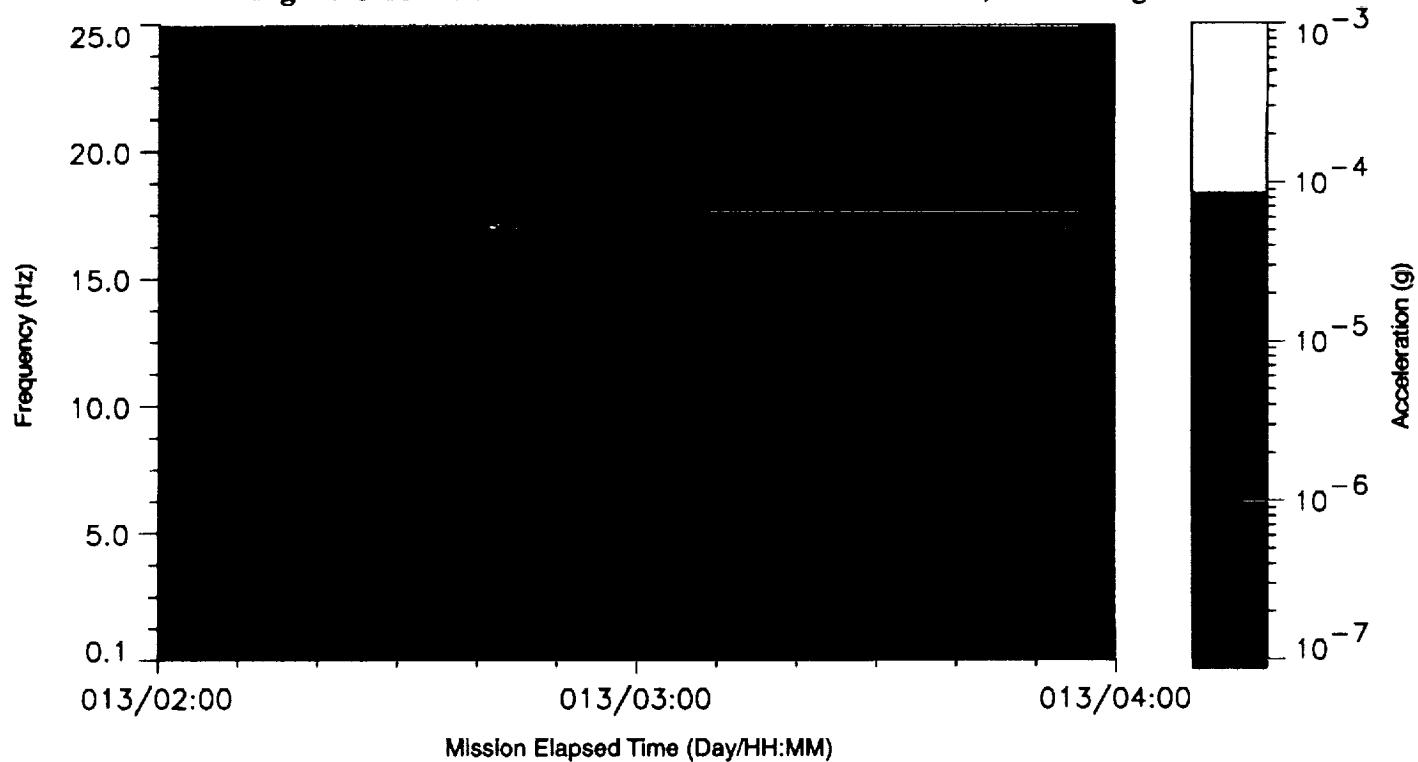
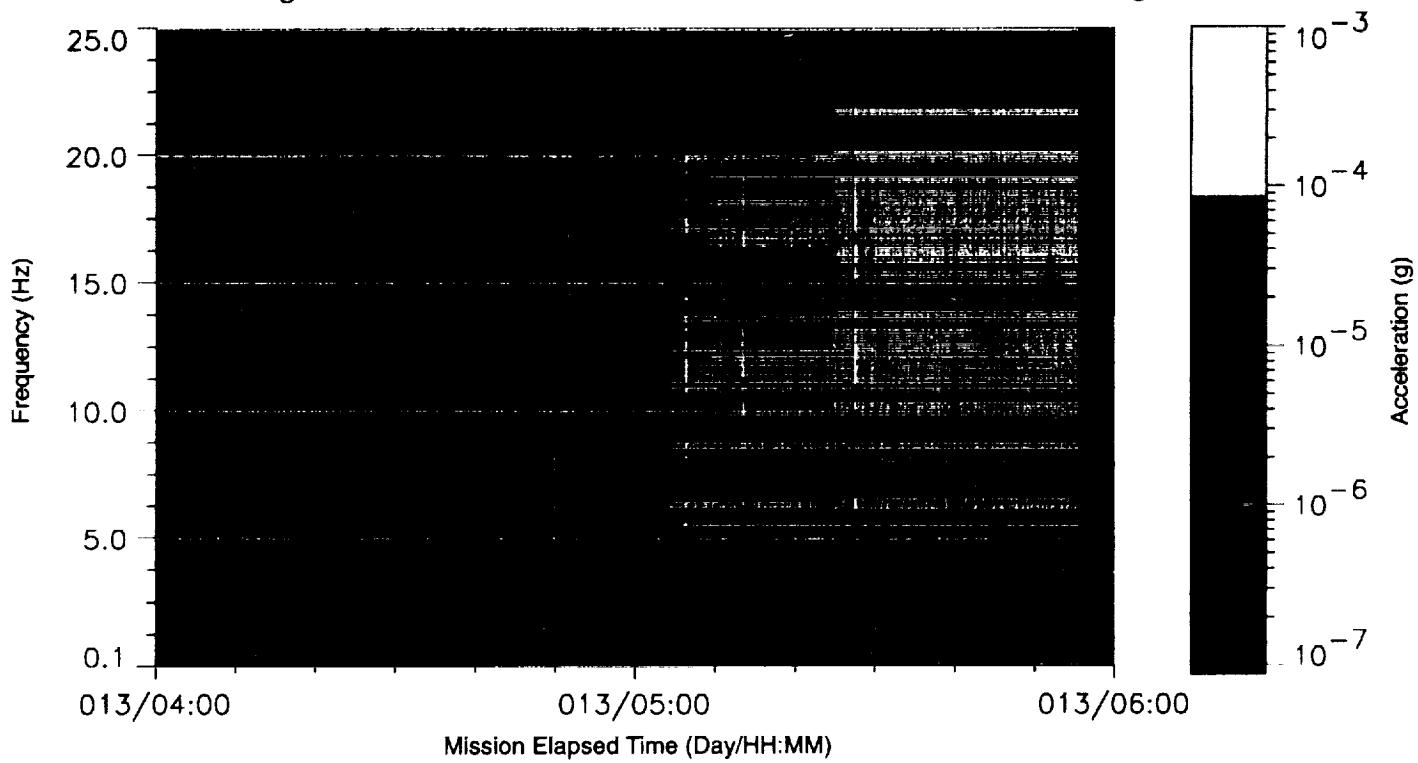


Figure C-111 USMP-2 Port Side of Orbiter Center Line, Vector Magnitude





SUMMARY REPORT OF MISSION ACCELERATION MEASUREMENTS FOR STS-62

Figure C-112 USMP-2 Port Side of Orbiter Center Line, Vector Magnitude

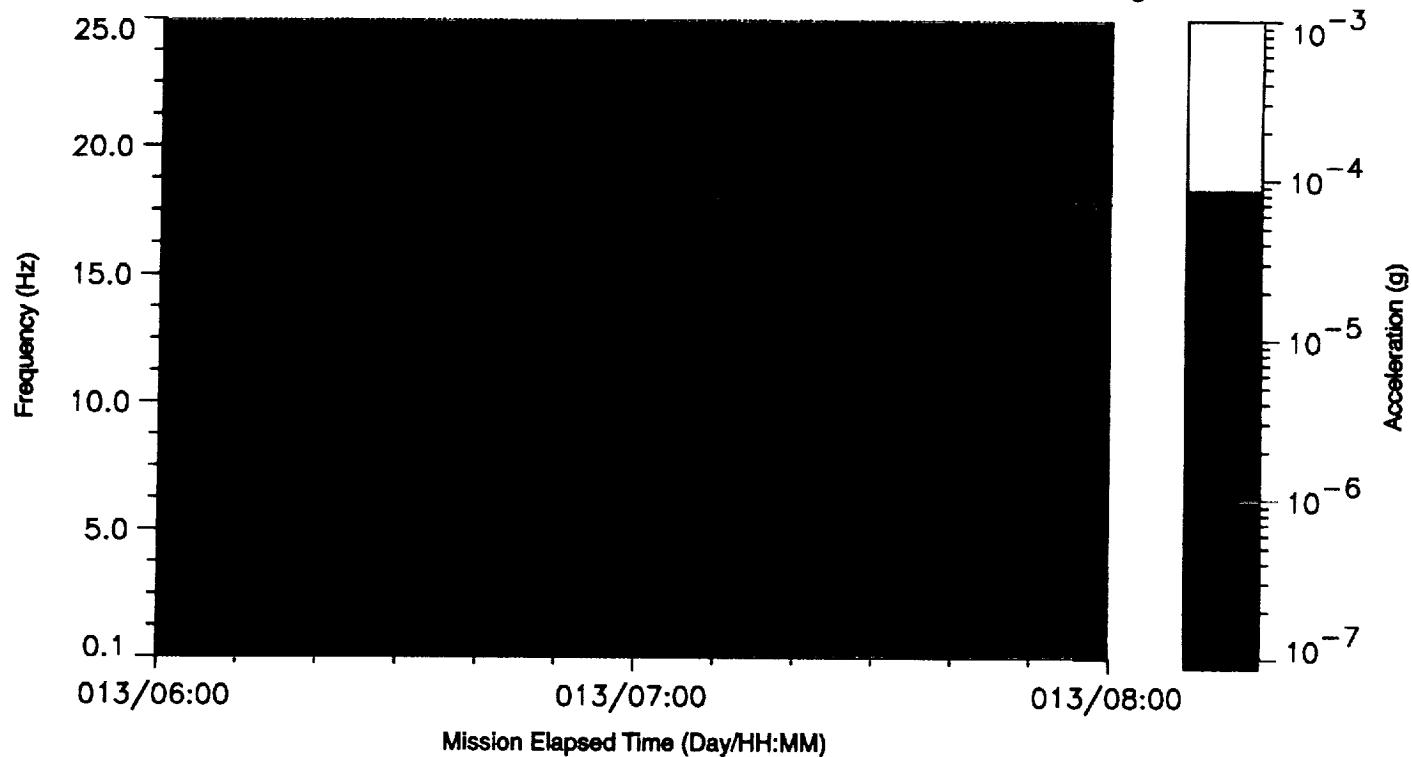
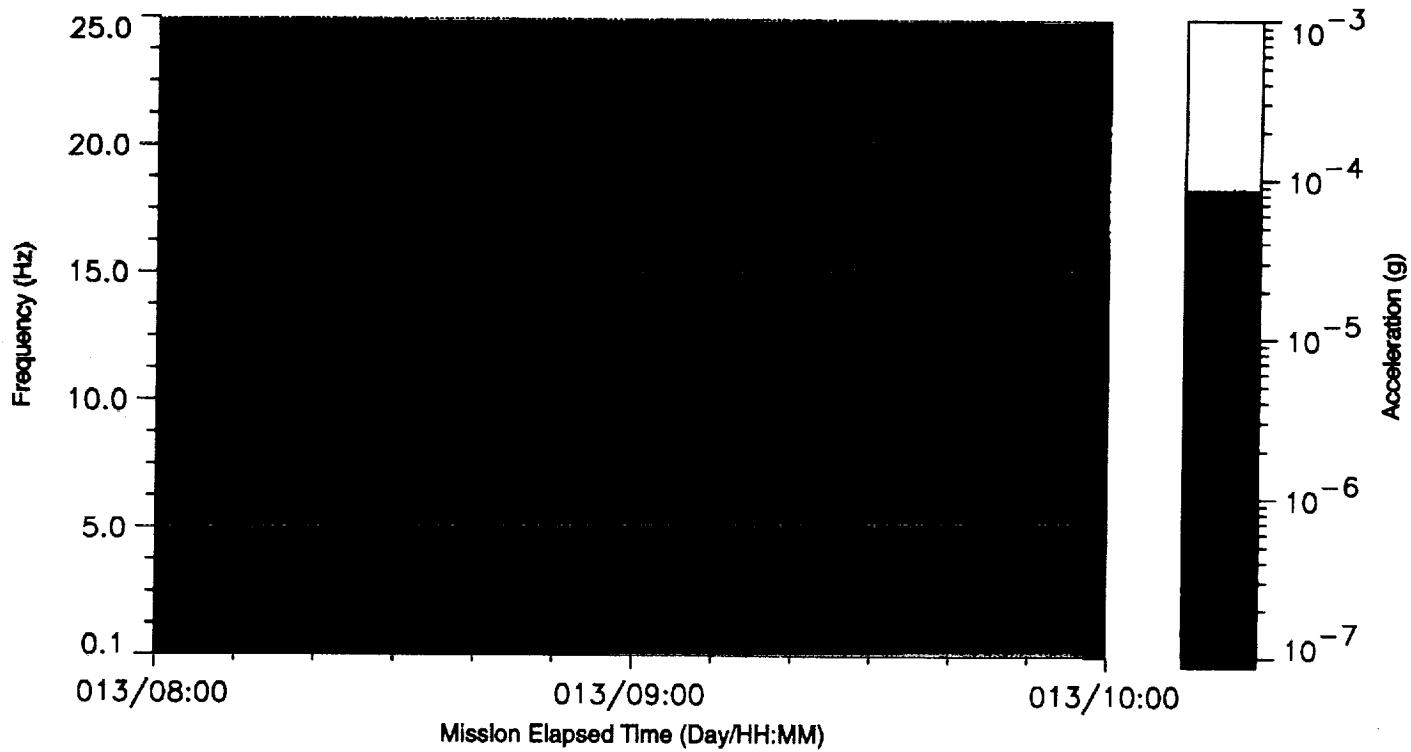
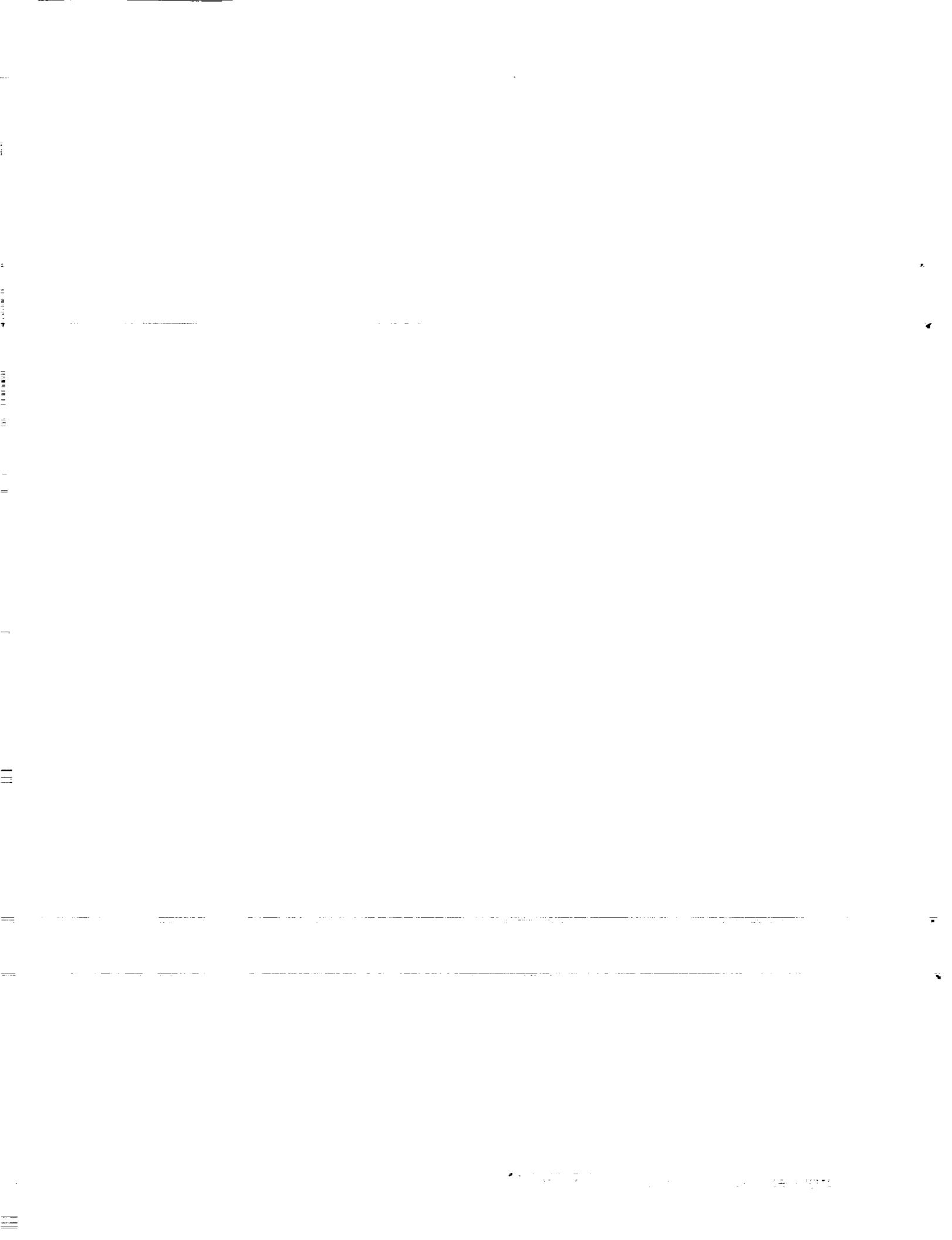


Figure C-113 USMP-2 Port Side of Orbiter Center Line, Vector Magnitude





APPENDIX D OARE TIME HISTORIES

Accelerometer data collected on Orbiter missions are generally analyzed by the PI or experiment team responsible for the system. The PI Microgravity Services (PIMS) project at the NASA Lewis Research Center (LeRC) was formed in part to support microgravity PIs in the evaluation of acceleration effects on their experiments and to characterize the vibrational environment of the microgravity carriers and vehicles. OARE data collected during STS-62 are presented in Appendix D to provide PIs with an overview of the quasi-steady environment during the mission. The OARE data presented in this report are data saved to EEPROM during the mission and compensated post-flight by Canopus Systems, Inc. for scale factor and bias. The data are presented in Orbiter body coordinates. OARE data in this form are available via a NASA LeRC file server. See Appendix A for information on file server access of OARE data.

Fig. D1 shows the environment recorded by OARE during the extent of the mission. Notable features of the data in Fig. D1 are the differences in acceleration levels between periods when the crew was active and inactive and between the USMP-2 (up to about MET 230 hours) and OAST-2 (after MET 230 hours) portions of the mission. The vibration environment is reduced during crew sleep periods compared to periods of crew activity because some equipment is turned off and crew push-off forces are minimal or non-existent. Fig. D2 is a fifty hour segment of data from Fig. D1. The difference between crew sleep and crew wake periods is evident in this figure. The peaks in the data at about MET 76 hours and the data shift at the same time are related to flash evaporator systems and water dump operations. This is discussed in the body of this report. Fig. D3 is a four hour segment of data from Fig. D1. Detailed interpretation of OARE data and comparison with modeled data are done at this time scale.

SUMMARY REPORT OF MISSION ACCELERATION MEASUREMENTS FOR STS-62

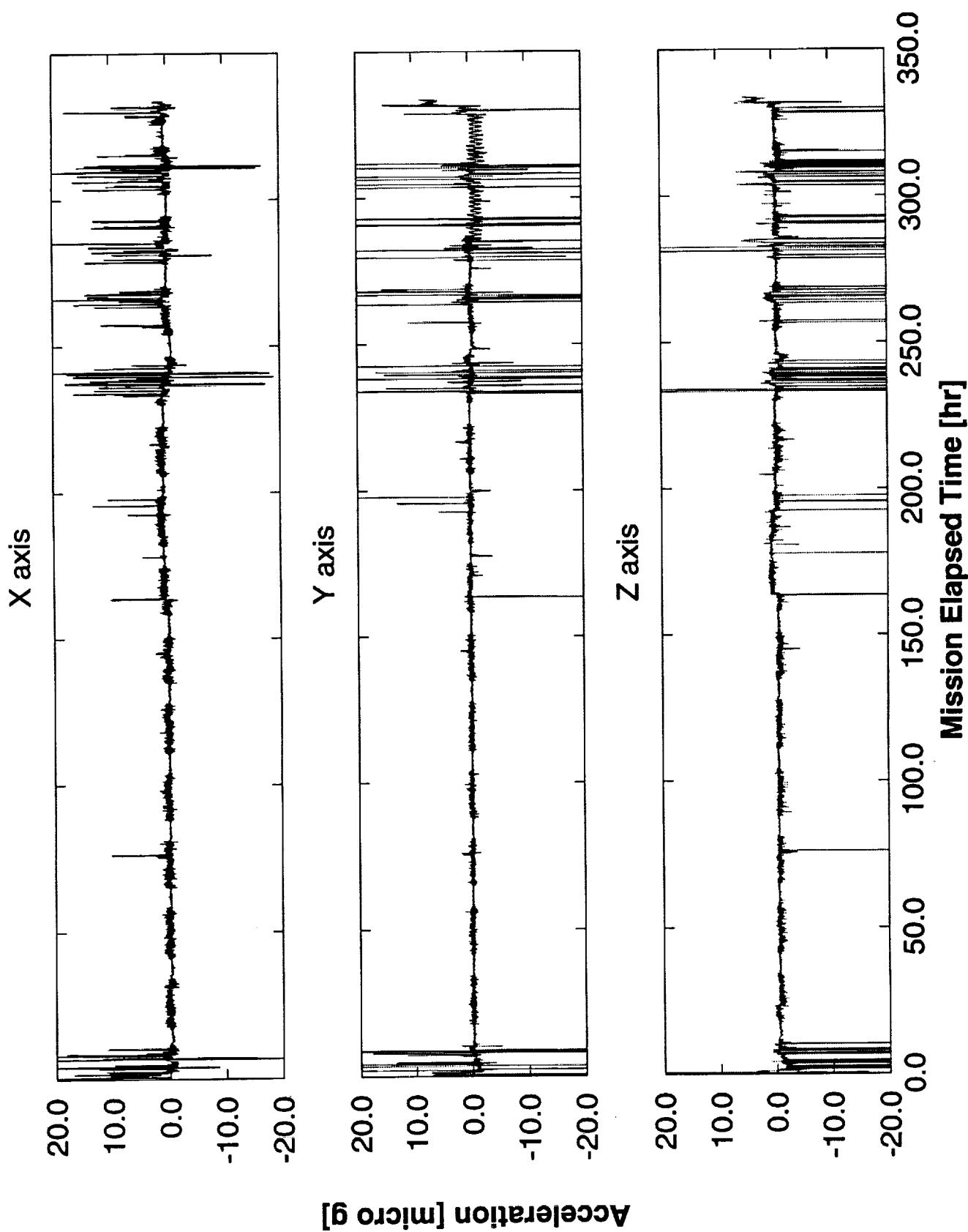


Figure D1

D2

SUMMARY REPORT OF MISSION ACCELERATION MEASUREMENTS FOR STS-62

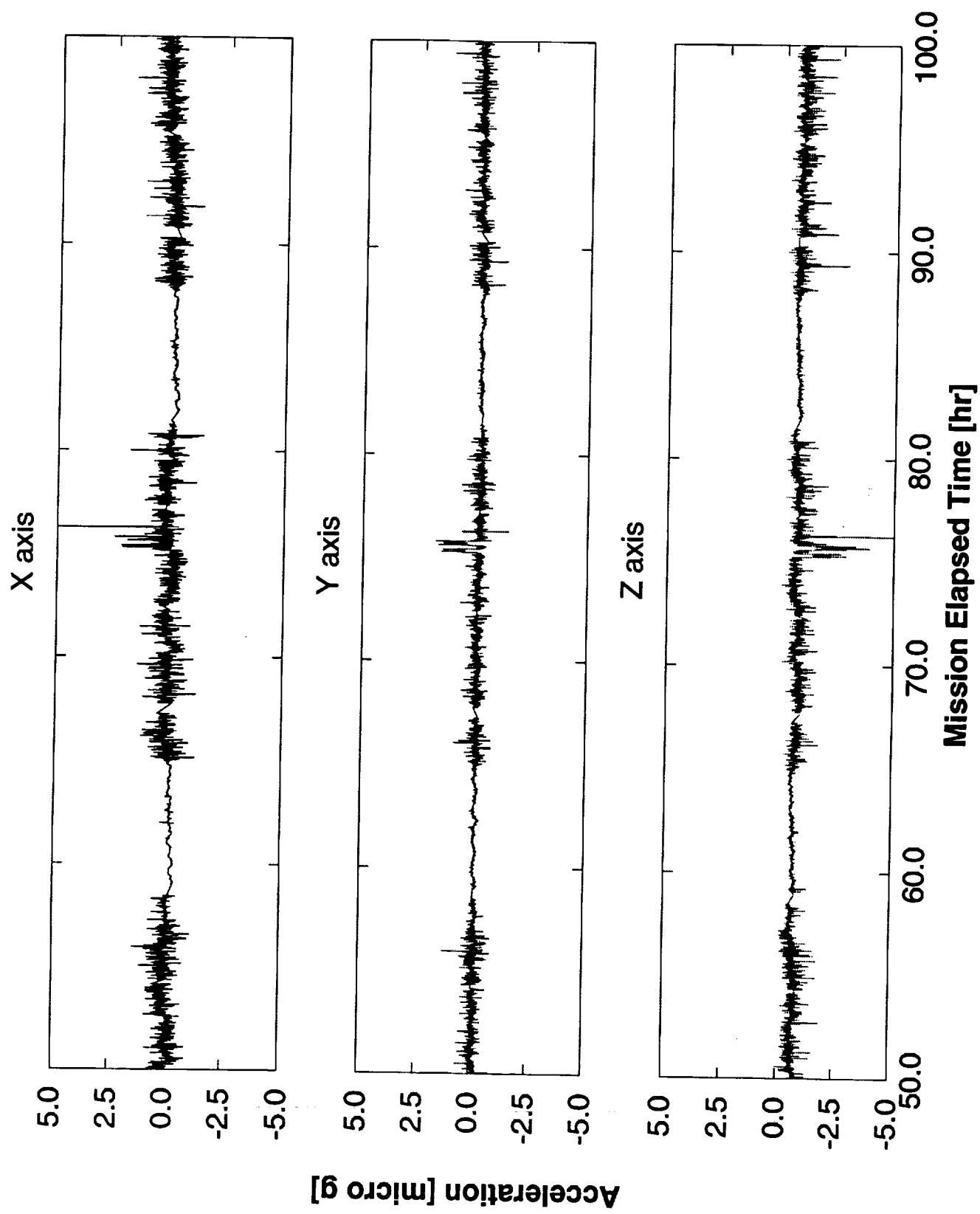


Figure D2

SUMMARY REPORT OF MISSION ACCELERATION MEASUREMENTS FOR STS-62

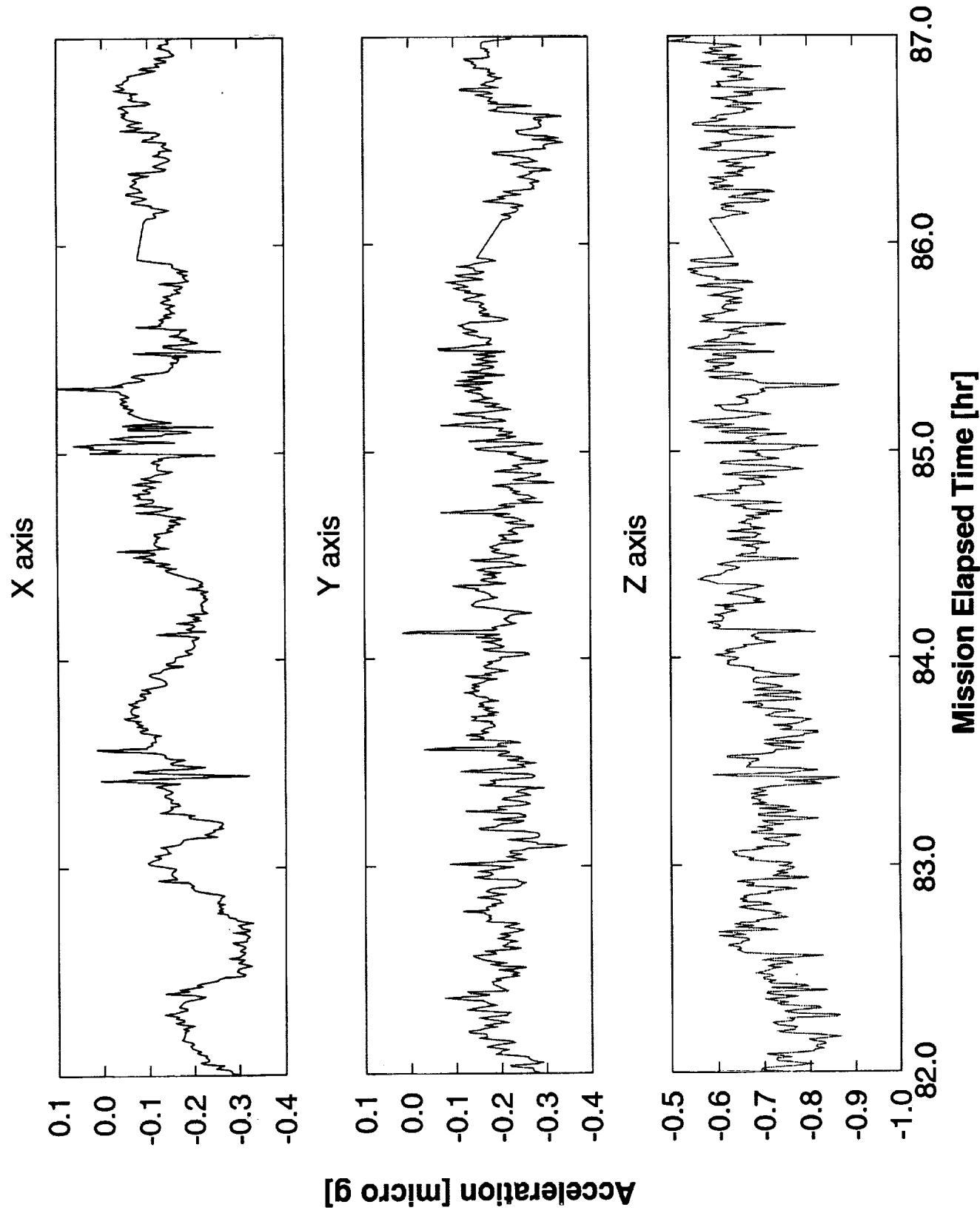


Figure D3

SUMMARY REPORT OF MISSION ACCELERATION MEASUREMENTS FOR STS-62

APPENDIX E USER COMMENTS SHEET

We would like you to give us some feedback so that we may improve the Mission Summary Reports. Please answer the following questions and give us your comments.

1. Do the Mission Summary Reports fulfill your requirements for acceleration and mission information? Yes No If not why not?

Comments:

-
-
2. Is there additional information which you feel should be included in the Mission Summary Reports? Yes No If so what is it?

Comments:

-
-
3. Is there information in these reports which you feel is not necessary or useful?

Yes No If so, what is it?

Comments:

-
-
4. Do you have internet access via: ftp mosaic gopher other? Have you already accessed SAMS data or information electronically?

Yes No

Comments:

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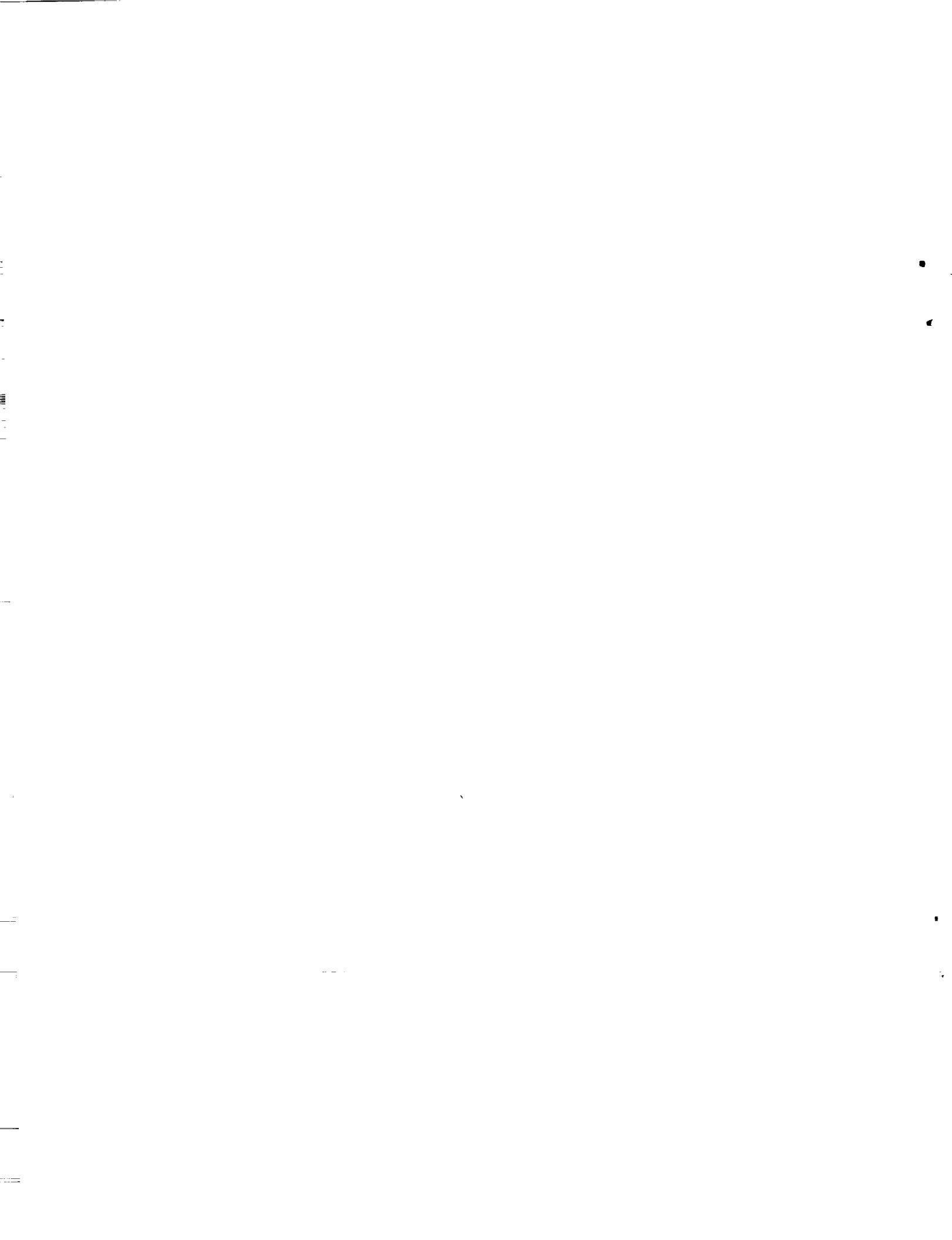
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Cleveland, OH 44135

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FAX to PIMS Project: 216-433-8545

e-mail to: pims@lerc.nasa.gov



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| 12a. DISTRIBUTION/AVAILABILITY STATEMENT Unclassified - Unlimited Subject Categories 29, 35, and 18 | | | 12b. DISTRIBUTION CODE | | | |
| 13. ABSTRACT (Maximum 200 words) The second mission of the United States Microgravity Payload on-board the STS-62 mission was supported with three accelerometer instruments: the Orbital Acceleration Research Experiment (OARE) and two units of the Space Acceleration Measurements System (SAMS). The March 4, 1994 launch was the fourth successful mission for OARE and the ninth successful mission for SAMS. The OARE instrument utilizes a sensor for very low frequency measurements below one Hertz. The accelerations in this frequency range are typically referred to as quasi-steady accelerations. One of the SAMS units had two remote triaxial sensor heads mounted on the forward MPRESS structure between two furnace experiments, MEPHISTO and AADSF. These triaxial heads had low-pass filter cut-off frequencies at 10 and 25 Hz. The other SAMS unit utilized three remote triaxial sensor heads. Two of the sensor heads were mounted on the aft MPRESS structure between the two experiments IDGE and ZENO. These triaxial heads had low-pass filter cut-off frequencies at 10 and 25 Hz. The third sensor head was mounted on the thermostat housing inside the IDGE experiment container. This triaxial head had a low-pass filter cut-off frequency at 5 Hz. This report is prepared to furnish interested experiment investigators with a guide to evaluating the acceleration environment during STS-62 and as a means of identifying areas which require further study. To achieve this purpose, various pieces of information are included, such as an overview of the STS-62 mission, a description of the accelerometer systems flown on STS-62, some specific analysis of the accelerometer data in relation to the various mission activities, and an overview of the low-gravity environment during the entire mission. An evaluation form is included at the end of the report to solicit users' comments about the usefulness of this series of reports. | | | | | | |
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